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THE ASIAN AND PACIFIC SCENE

GEOGRAPHICAL REVIEWS

The Origin, Nature, and Distribution of Agricultural Terracing

J. E. SPENCER and G. A. HALE

Among geographers concerned with the works of man on the surface of the earth, there are several categories of phenomena that have attracted attention as the chief forms of human imprint. Many geographers have concerned themselves with settlements as features producing the most significant and permanent imprint. Others have considered the combined stamp of agricultural clearing of wild vegetation and the elaboration of domestic planting patterns. To some the use of fire in destroying the forests of the earth and in inducing the spread of grasslands is a major tool in impressing a human mark on the surface of the earth. Soil erosion produced by agriculture and other types of culturally induced erosion appear to some students as the chief human mark. In the modern era there is some validity in the suggestion that the patterns of trails, roads, and highways, recently involving the great freeway or throughway systems, are becoming significant marks of human modification of the surface of the earth.

Rather curiously there has been profound neglect for another of the great categories of alteration of the surface of the earth — the agricultural terracing that is spread so widely. Most geographers who have considered the terrace have viewed it as the expression of the influence of environment on man, with the conclusion that where flat lands suitable for agriculture do not naturally exist man has been forced to create such surfaces artificially. Photographs of a very small number of classic illustrations of wondrously terraced slopes normally are exhibited as proof of this thesis, the most famous single case being that of the Ifugao terraces at Banaue, northern Luzon, in the Philippines. Students not caring to expound this particular thesis usually have ignored the matter of terracing, accepting it almost without comment as an incidental and unimportant phenomenon in the development of the agricultural landscape and, in this respect, are like the hardrock geologists who totally disregard alluvium.

It is the suggestion of this article that agricultural terracing constitutes one very important category of phenomena stamping the perman-

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ent imprint of man on the surface of the earth. Terracing is here viewed as expressing a cultural technological ability of man carried out to improve upon the natural landscape rather than as expressing the influence of environment over man. Agricultural terracing transforms the natural slope of landforms, alters the patterns of natural drainage, changes the profiles and development of soils, counteracts natural cycles of erosion, produces culturally controlled sedimentation and the growth of softer than natural landform profiles, and produces a cultural landscape more valuable to man that the one provided by nature. The distribution of terracing does not agree at all with the distribution of agriculture in the rough lands of the earth so that it is a matter of culture rather than one of environmental influence. Agricultural terracing has a very old history in the hand of man, and today is very widespread over the world. As such an important imprint it deserves far more attention than it has received from all disciplines concerned with human occupation of the earth.

The terracing traditions, as such, appear to be clearly differentiated from the major traditions of hydraulic engineering, though at a late date in some areas the two met and became partially integrated. Certainly the early development of terracing did not take place in the great river valleys where the chief expressions of flood control are to be found. The major hydraulic situations involved concentrated political power, large volumes of labour, large flat landscapes, and large-scale works, whereas the early story of terracing, if not the whole story, is related to local situations, activity by individuals or small groups, acting in co-operation but not in centralised schemes, and to landscapes marginal to the great lowlands. It is only late in the development of terracing traditions that the terrace spread out on to such major lowlands as were already protected by hydraulic works. [1]

DEFINITIONS, PRESCRIPTIONS, AND LIMITATIONS

Our English word terrace, in one usage, signifies an artificially flattened surface whose plane is more horizontal than the plane of the natural land surface originally present. The term expresses no horizontal dimensions, contains no quality reference, does not define the procedure by which the flattening is produced, and says nothing about its use. It is necessary, therefore, to prescribe frames of reference for the discussion of agricultural terracing. In the strict sense of the term

[1] Wittfogel (1957) makes no mention of terracing. Terracing was but little associated with the lowlands of the Nile Valley, the Tigris–Euphrates, the Indus, or the Yellow River in the early period. It comes late into the lowlands of the Ganges Valley, the Yangtze Valley, and the great river valleys of southeastern Asia.

there are many kinds of surfaces which, conceivably, may be termed terraces. Obviously omitted from consideration are terraces built for the erection of buildings, terraces involved with military fortifications, and terraces designed for recreational, ceremonial, and other such non-agricultural uses. In simplest terms the agricultural terrace may be conceived as any artificially flattened surface on which crops are grown subsequent to the flattening, no matter how small, how crude, or how purposeful. In this simple description there are many sorts of surface flattening, and many ways of achieving it, that properly lie outside our discussion.

The placement of any kind of obstruction laterally across a slope will induce accumulation of mineral and organic soil material behind it, resulting in a flattening of a portion of the surface of the slope. Rocks can be laid in rows, the soil surface may be slightly scarified, brush may be piled in lines, felled tree trunks may be aligned to some degree, or fences may be built laterally. Lateral paths used by cultivators and by domestic animals in their grazing may create flattening of slopes. The very patterns of planting adopted by some peoples on many occasions achieves a certain element of slope flattening. Such incipient terracing may be found almost all over the agricultural world. The very simplest, and possibly the first, of human efforts at terracing may have been little more than such activities. Though we will return to the subject of incipient terracing, it is not with such elemental activities that this article is concerned.

The consideration of true agricultural terracing separates itself into two parts at the outset. First are the ancient techniques of terrace building, widely distributed over the world but being only slightly employed in the elaboration of agricultural landscapes in the present century.[2] Second are the modern and contemporary techniques of contour cultivation, employing mechanical equipment and creating a different order of terracing. The latter system has achieved wide distribution already, is still expanding rapidly, and, in many areas, is superseding the older techniques and types of terracing in the expansion of agriculture on to new lands.

This article constitutes an enquiry into the nature and the origins of the older order of terracing, concerning itself with the classification of different purposes of terraces, their possible origins, and with the distribution of the traditional variety of terracing. It must be considered a very preliminary enquiry, for the investigation of, and the literature pertaining to, the nature and building of terraces is singularly small. Many writers concerned with landscapes in many parts of the world

[2] A notable exception is the Communist Chinese mobilisation of local labour to greatly expand the traditional terrace patterns of northwest China as an element of flood control and reforestation. Buchanan (1960): 22–6.

have failed even to mention the presence of terracing in the landscapes they treat.

THE NATURE AND FORMS OF TRADITIONAL TERRACING

Since there are many kinds of agricultural terraces in many kinds of environments, they must be examined from several points of view, even though the end purpose of all terracing is to make cropping more possible, more productive and easier. Any agricultural terrace may be considered in two different ways. It may be viewed functionally as the field surface created by the act of terracing, leading to the recognition of different kinds of fields with different degrees of horizontality, usable in different ways. Alternatively the terrace may be viewed technologically as the artificially compounded device designed and executed to produce a field in different ways, leading to the recognition of several kinds of technological procedures employed in creating agricultural terraces. Individual final consideration of a terrace must, of course, integrate the alternative views to permit recognition of an end product, a specific type of terrace, built in a given way, to produce a crop field that can be operated in a particular manner in a specific ecologic situation.

Traditional terracing procedures must be approached from the standpoint of simple beginnings and initial aims, with consideration of the varying physical environments in which the first developments may have occurred. Even the first simple efforts at terracing must have been carried out to yield cropping surfaces better than those available on the natural surfaces of the land. This involves recognition of landforms, the nature of the regolith, the character of soils, precipitation regimes, and the nature of surface waters. But it also involves consideration of cultural organisation, general abilities, and technical skills.

A tentative listing of the most general aims of all agricultural terracers, in all kinds of geographic environments, among all levels of culture, yields the following series:

(a) Procedures creating cropping surfaces initially little modified from the natural surface, the cropping of which must depend upon spreading naturally flowing water over the field surfaces to provide ground water for crop growth.

(b) Procedures creating cropping surfaces more horizontal than those occurring naturally, the cropping of which could depend upon natural precipitation only.

(c) Procedures creating cropping surfaces more horizontal than those occurring naturally, the cropping of which could depend upon water diverted from natural streams and introduced through irri-

gation channels to the cropping area.

(d) Procedures achieving retention of soils on existing cropping surfaces, questions of soil moisture being initially secondary.

(e) Procedures creating cropping surfaces in terrain not naturally arable in its rocky condition, questions of soil moisture initially being secondary.

(f) Procedures creating horizontal surfaces on which water may be impounded for the establishment of wet fields, on which water stands at some desired depth during the cropping period.

It follows that once terracing had been started in any area, the human recognition of possibilities may have led to a combining of two different aims in the same area, permitting the extension of terracing through a hybrid terrace type designed to achieve both aims. It follows also that with experience, increasing skills, and additional manpower, an initial simple aim may have evolved into a more complex aim, giving rise to technological modification which enabled the building of terraces in areas in which they originally could not have been built. It must also be recognised that if a general aim in terracing were applied to a different environment the aim itself might be altered. If this occurred in the hands of the skilled builder of terraces, advancing technological change might yield a new kind of terrace. But if the technique of terrace building were copied by another people not previously acquainted with terracing, the alteration of the aim under less able technology might well have been toward initial simplification, also giving rise to a new kind of terrace but in a recessive line of development. The later history of agricultural terrace building may well involve many such deviational developments, yielding both more advanced and simpler terracing procedures.

Since it is as yet uncertain where agricultural terracing began, what the initial aims of the first terracers were, and what technological devices were initially employed, it is impossible to set up a firm series of terrace categories, either in evolutionary sequence or in regional sequences. It is, then, necessary to project the possible products of general aims into a listing of the different specific kinds of terraces that may have been constructed over the long period of terrace building. Without attempting to develop every theoretical permutation, but with the aim of including types of terraces for which we have found record, the following tentative list may be set down:

1. The low, simple, and gently sloping terrace built in an open and non-entrenched drainage channel, employing a simple weir to spread naturally flowing water over a wider than natural surface, in such manner as to soak the surface and cause the accumulation of silt. The weir may be of rocks, earth, and vegetative material in any uniform or mixed pattern of composition.
2. The high terrace built in a narrow drainage channel in an area

of marked relief, employing a massive stone barrage across the channel which causes silting behind it to produce a small field, nearly horizontal and periodically soaked by naturally flowing water.

3. The rock-embanked but non-contour terrace with a sloping field laid out across a slope, without facilities for artificial water, dependent upon natural precipitation for soil water.
4. The isolated, short, single field terrace created by crude rock embankment and by back-slope digging and fore-slope filling, to create a single small but less steep field, dependent upon natural precipitation for soil water.
5. The rock-embanked contour terrace with gently sloping field, starting near a stream channel from which irrigation water may be diverted to irrigate the terrace.
6. The rock-embanked buttress or bastion terrace, built laterally across a slope, making no attempt to create a true field, but supporting crop trees on slopes.
7. The low, simple, mud-walled terrace built on a flat-floored stream bed, sometimes reinforced with stone and vegetative materials, impounding naturally flowing water to create wet fields which hold water during the growing season.
8. The contour terrace laid out laterally across slopes, with a truly horizontal field, using embankments to impound water on wet fields, dependent upon water derived from a higher terrace or upland source.
9. The aquatic field-pond created by excavation or by mud embankments less than dam-size, within a wet field terrace zone, to serve as an aquatic field and as a source of water for other wet fields above or below.
10. The excavated pit field dug into a surface to create a wet-soil field closer to the water table.

There may be other specific terrace types which should be added to the above list. Of the purposes suggested in the foregoing list of general aims all cannot be met by precisely the same form, shape, and construction of terrace, so that there must be many different kinds of terracing. It is true that, superficially, many of the varieties of terraces appear very much alike, in the same way that almost all people, houses, or automobiles have superficial similarities. It certainly is true, of course, that a given type of terrace construction may serve more than one general purpose in certain environments. It is equally true that in any given environment the builders of terraces have sought to achieve only a few of the varieties of purposes for which terraces may be built. The terrace built for a specific purpose in a given situation in a particular environment is something tailored to its location by its builders, and it is necessary to analyse both the terrace

patterns and the situations in which terraces are constructed. Relatively slight modifications in the technical construction of a terrace may serve to alter its purpose. For example, a slight alteration in the height of the earth fill behind an embankment can transform any horizontal terrace pattern into a pattern designed for either a wet or a dry field.

The descriptive technical elements, and the corresponding situations, are suggestively spelled out in the following sections, whose numbers correspond to the numbers previously listed.

(1) *Channel-bottom, weir terrace.* What may be one of the very simplest forms of true terracing is that produced by a simple weir built laterally across the bed of a shallow water course which is not entrenched, and which normally would not carry a large head of water. [3] Such a terrace is to be found across flow lines of slight gradient near lowland margins, wherein apron surfaces lie adjacent to the drainage channel. [4] The weir was built low and only a very slight amount of labour was involved in making the field a planting surface. The ponding of naturally flowing water produced a certain element of sedimentation, further levelling the surface, thus requiring little in the way of formal terrace-filling operations.

In this type of terracing no attempt was made to create a level field, for the purpose appears to have been to spread the natural flow of water over a wide surface, to provide sufficient soil moisture for the growing of crops. The deposition of silt over the surface must originally have been an incidental item, but capitalised upon, and eventually fostered. Surplus water was permitted to proceed down-

[3] There are too few common words, well defined, that are roughly equivalent to dam and embankment. In this article the term *weir* is used for any check dam built up to or near to the level of the field behind it, used in situations in which free flowing water purposely is permitted to flow over the dam to the field below. The term *barrage* will be used only for a thick dam, double-faced with rock and filled with earth, erected to impound a considerable depth of water to produce sedimentation behind the embankment. A formal spillway, paved with stone, is a normal accompaniment of the mature technology. The term *wall* will be used for any embankment built to the level of the field behind it in situations in which free flowing water would not normally flow over it to the field below. The term *bund* will be restricted to the embankment built above the level of the field behind it for the purpose of impounding water on the field during the growing season, thus to create a wet field rather than to produce sedimentation. The term *bund* in English-language usage in eastern and southern Asia, does have other application also (the dam of reservoir, the front margin of an artificially reinforced river bank, the flat top surface of that river bank), but it is the common term by which to refer to the rice field embankment. The term *embankment* will be used in the purely general sense, applicable to any of the specific forms.

[4] Bury (1919): 101-3, briefly discusses this type of terrace in the Tihama of Yemen.

grade to the next terrace unit along the original flow line. Small to moderate sized fan-shaped fields resulted from this type of terracing, with the numbers of units ranging from two or three to dozens. Such terraces appear in the very dry areas of the Near East in areas of low local relief, in which crop maturity could not depend upon natural precipitation. It possibly represents one of the very simplest and earliest forms of terracing. How widely distributed this form of the terrace may have been at one time is not clear. At first glance it may appear to be an arid land terrace applicable only to the flat, open margins of hill country, but terrace type (7) is almost identical in general nature, simplicity, and pattern, though it is applied to a different end. The channel-bottom, weir terrace probably served as the model for another terrace, type (2).

(2) *Narrow channel, barrage terrace.* In the rougher hill country of parts of the Negev, in southern Israel, there are hamada-paved uplands, with stream channels cut into the surfaces, producing considerable local relief, and there are few flat areas easily cultivable and provided with water in this arid land. Aligned along drainage courses today appear hundreds of terraced fields. These were produced by building massive stone barrages right across the narrow channels. Removal of hamada-paving from uplands increased erosional action thereon, bringing volumes of sediment down with the runoff of random rains which deposited a thick layer of material behind each barrage. In time this became thick enough to provide a cultivable field, watered by the periodic natural flow of drainage water.[5] Eventually the barrages became filled, and the process could be extended on downstream, or further upward.

The distribution of this kind of terrace is poorly reported. It appears to be a type belonging to a very arid region, wherein natural precipitation is too slight to mature crops. It is applicable to areas of quite varied local relief. It certainly cannot be a first step in terracing, because the construction of the massive stone barrage is not something that could be done without considerable stone-working technology.[6]

(3) *Linear sloping, dry field terrace.* Crude stone walls may be built laterally across sloping surfaces, accompanied by back-slope digging and earth filling of the fore-section against the embankment to produce flattened fields. No attempt may be made to produce a field which is essentially horizontal but merely one which is flatter than the

[5] Kedar (1957A): 186.

[6] Evenari, Aharoni, Shanan, and Tadmore (1958): 231-43, investigated Judean period (850-600 B.C.) terrace remnants in the Negev which were cruder and simpler in their construction than the later Nabataean, Roman, and Byzantine terraces. Further investigation may push terracing much farther back in time, and may permit us to see a sequential development of the narrow channel, barrage terrace.

original surface. This results in a field surface which may have a considerable forward slope to the wall, and which may have considerable longitudinal variation in level, and is not a contour terrace properly speaking. When built in regions having a considerable precipitation, which can mature crops without artificial water, levelness is not a prerequisite for a successful terrace of this type. Such terraces may be built in areas with no facilities for irrigation, since the absorption of natural precipitation will be adequate to support crop growth, be it field crops, shrubs, or trees, and whether it be by dry-farm practice, precipitation-season cropping, or normal summer growing season cropping.

This terrace would appear to have originated in some region having a seasonally moderate precipitation regime. It became applicable to many different kinds of situations, and to many different varieties of local relief as its technology matured. Efficient construction of the embankment could carry it into quite rugged areas. Such terraces are distributed widely over the world, and the form appears to be one of the most common varieties of terracing in areas with precipitation regimes adequate to producing crops without irrigation.

(4) *Isolated, short, sloping dry field terrace.* In several regions terracing does not produce serried rows across a whole slope, but yields isolated and single terrace fields, scattered at random over a slope. Such terraces are flatter than the natural slope, and represent individual efforts of a small order, confined to a single field, the expression of continued occupance of a given site. In such cases apparently slope cultivation is first practised, but in time the beginnings of rough terraces take shape. Over the years the front walls are raised progressively by the placement of crude stone blocks, and back-slopes are dug down to fill the front portions. This form of the terrace can never produce a horizontal field, and its technology is both crude and simple.

Perhaps this is a transitional form of terracing in the hands of some people not highly skilled in stone work and terrace building in general so that it may be a variety of its own. Western China, could achieve technologically careful and wholesale terracing. But it appears also that it may be the full expression of terracing among a people not high skilled in stone work and terrace building in general, so that it may be a variety of its own. Western China, Himalayan India, and portions of Southeast Asia show this type of terracing, but its wider distribution is uncertain. In Himalayan India shifting cultivation on fairly steep slopes often is succeeded by permanent field agriculture employing this kind of terracing to produce a field easier to work. [7]

[7] Pant (1935): 87.

(5) *Linear contour, irrigable terrace.* By the building of a stone wall laterally across a slope on the contour, and by filling it with earth to form a nearly horizontal field with a slight end-to-end gradient, an irrigable field is created. The fill does not have to be truly horizontal in any direction, but it should maintain only slight gradients outward and longitudinally. This type of terrace will absorb such precipitation as normally falls on it as light to heavy rains, but it will not absorb extended heavy downpours of rain. When it is built in areas having frequent heavy rains there must be the provision of drains to dispose of surpluses of water not essential to the use of the terrace. By its construction it is a type of terrace that permits relatively easy irrigation, providing a source of water is available at all.

Perhaps this terrace type originated in areas lacking quite enough natural precipitation to mature desired crops, but having water in streams, drainage channels, or in springs. The building of a small rock wall down contour, away from such a source, and filling it properly, would produce a field requiring only a very short and simple diversion channel to get water on to the terrace. As seen today in many parts of the Middle East, such terraces begin close to water sources, with heavy rock embankments near the sources, the walls thinning out away from the source, with the field sometimes losing its smooth contour at a distance from the water source.

This type of terrace obviously is one depending upon irrigation, and would seem to have developed in areas with too little precipitation for successful cropping by the use of terrace type (3), above. The mature development of this terrace type shows elaborate handling of water devices.[8] Series of such terraces can line a slope, particularly where a rough upland provides a source of water.[9] This is perhaps the most common form of terrace in many of the foothill portions of semi-arid upland sections of the Old World. A great many of the New World terraces appear to be of this type, and many such Andean terraces are provided with elaborate drain systems to remove unwanted surpluses of water.[10] The full distribution of this type of terrace is imperfectly reported, frequently being confused with terrace type (3).

(6) *Tree-crop, buttress terrace.* When long-lived crop trees or shrubs are grown on essentially sloping lands, rain wash, soil erosion, and under-cutting may expose roots, weaken ground supports, and otherwise cause the decline, fall, or death of the trees and shrubs. In many such situations terracing of a sort is done to provide permanent support for the desired plants rather than to produce a full crop field. In such cases irregular or semi-continuous walls are built that produce a terrace

[8] Swanson (1955): 126-7; Hall (1909): 236.
[9] Haig (1887): 482.
[10] Swanson (1955): 126-7.

effect without producing full terraces. Such walls often have a high batter, or rearward slope, and the walls commonly do not fully enclose the bases of trees.[11] Such terracing is common in the whole of the Mediterranean Basin and the Middle East, but its further distribution is not well reported. It would appear to be a derivative of simple terracing effected for a specific purpose of erosion control.

(7) *Stream bed, wet field, mud terrace.* In portions of the Orient in the modern period there are some culture groups which have not used the full wet field terracing complex described below, but who do grow wet rice on wet fields on flat valley floors and other appropriate surfaces. Simple mud bunds, with informal sluicing gates, parts of the construction sometimes casually reinforced with stones, tree branches, bamboo, and other plant material, create wet fields in, along, or next to, lines of stream flow. Frequently almost no real filling or levelling is done to field surfaces, though natural silting under partially controlled water conditions does assist the levelling procedure. Unusual heads of water may wash out parts of the construction, or sweep the whole away, but crops often can be harvested without significant losses. This may have been a local development, or it might be the translation of the Near Eastern channel-bottom, weir terrace (1) into local ecologic situations. This is very simple terracing, involving little acute technology, and may be considered not to constitute proper terracing at all.[12]

The earlier distribution of such simple terracing cannot now be determined, since such simple patterns were long ago absorbed and submerged into the much more complex wet field terrace systems that cover the whole of valley bottom landscapes in many portions of the Orient, but the simpler elements may have been the base on which much of the later terrace complexes were built in many areas.

(8) *The wet field terrace.* Wet field terracing is truly horizontal field creation, and there are two distinct differences between it and previous varieties of terracing. First, the front embankment must be carried to a level above the fill material, providing a dam capable

[11] Observed by the junior author in Lebanon, especially in regard to olive trees.

[12] Among others, the Khasi used to practise something very similar to this around the margins of the Khasi Hills in northeastern India. Perry (1916): 14, considered this to be irrigated terracing. Hutton (1921): 393, argued that the Khasi practice was not terracing, since the Khasi had to be taught to terrace. Obviously the ability to build stream bed, wet field mud terraces did not automatically enable the Khasi to build the more complex wet field terracing systems built by other peoples such as Hutton had in mind. The Khasi practice, and others like it, certainly is not advanced and complex terracing, and it may have constituted a crude and down-scaled simplification of true terracing, but in our preliminary judgement the type of terracing done by the Khasis belongs in the broad discussion of terracing in general, and does constitute an elementary type.

of impounding water, but also capable of disposing of unwanted water. The bund seldom is constructed more than a few inches above the intended water level, but it must be proof against leakage. A critical element in bund construction is the provision of openings, sluices, or spillways, since good wet field terracing never uses the weir. The second difference lies in the filling of the terrace. The terrace behind the bund must be sufficiently carefully levelled that no more than a few inches of water are required to cover the whole of the field surface. If this is not done, growing conditions will be unequal, crops will not yield evenly, and they will not mature evenly.

Efficient wet field terracing is far more complex than is most dry field terracing. The complexity lies not in the construction of the bund, in most cases, nor in the levelling of the fill, but in the accompanying water control that is mandatorily efficient if a large terrace series is to be operated successfully. The provision of sufficient water for the whole of a series of terraces, often running into the hundreds in sequential arrangement down a slope, the regulation of flow patterns, the disposal of surpluses at needed points, the introduction of additional volumes, and the provision for flood situations makes wet field terracing both a co-operative and an exacting science.

Wet field terracing appears indigenous to some part of the Orient, but it is doubtful if the original and essential concepts of terrace building are indigenous to the Orient. Rather the wet field terrace would appear to be a modification evolved to suit the conditions of a particular cropping pattern. The spread of wet field terracing outside the Orient in earlier times was very limited, but in the modern period the concept has spread very widely indeed.

(9) *Aquatic field pond.* Within many sequences of wet fields there is deliberate terracing for the establishment of a shallow reservoir-like unit of water which normally has multiple use. Sometimes the bund of this unit becomes a true dam, being far thicker at the base than the normal field bund, but this is not always the case. The shallowness of the pond permits its cropping by the use of a variety of aquatic plants, fish, and shellfish. Its purpose, as water supply, is the provision of water to fields below or above the pond, but it is almost never just a reservoir, having aquatic cropping purposes as well. The distribution of this form of terracing, admittedly a special case, has been only partial within the zone of the wet field terrace. [13]

(10) *Sunken, taro-pit terrace.* The taro pit is an excavated field set below the general level of the land in order to bring the field surface nearer to a natural water table, and to impound rain water to assist

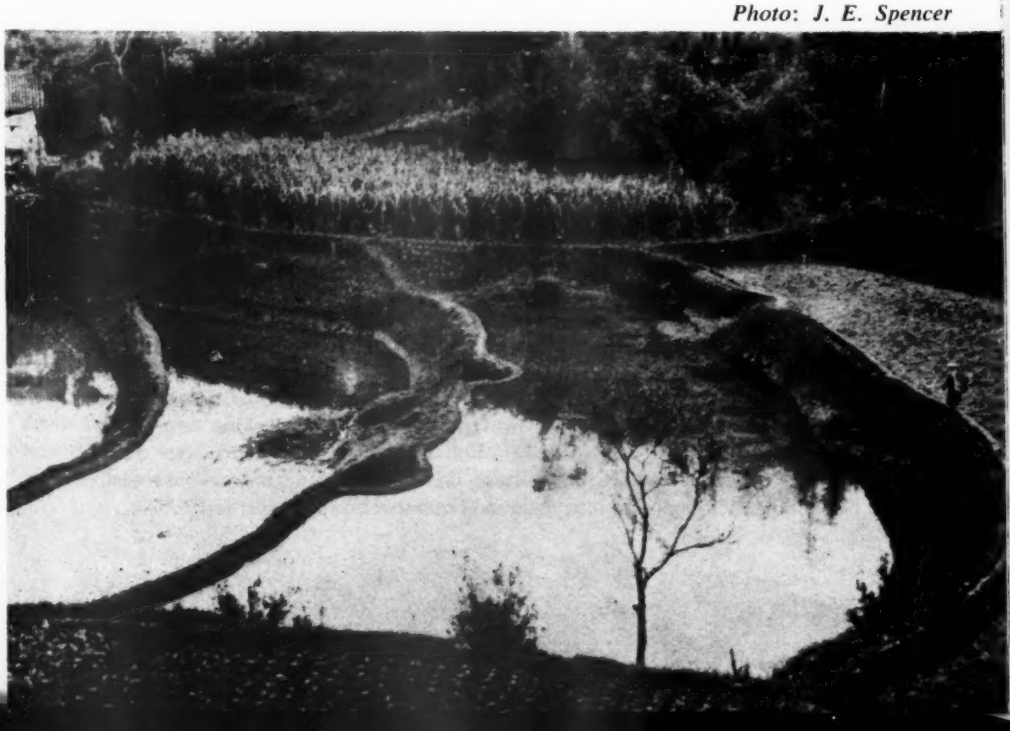
[13] Not included in this concept is the true reservoir, known as the tank, of India and Ceylon. The tank often is found along a stream valley, sandwiched in between several sets of wet fields, but its essential purpose differs from that of the aquatic field pond.

Fig. 1. A narrow stream valley head, with wet field terraces filling whole channel bottom. No drainage field lies above top terrace, hence no channel parallels terrace series until just below lowest visible field. Bunds are simple mud embankments. Western Hupei, China.

Photo: J. E. Spencer

Fig. 2. Four wet field terraces with simple mud bunds, in centre, showing wash-outs, temporary repairs, and field irregularities resulting from silting. The fourth, upper terrace now lacks water. Linear sloping, dry field terraces in background. Foreground terraces are wet field terraces in form, now planted as dry fields. Western Szechwan, China.

Photo: J. E. Spencer



in keeping a wet-soil field in sufficiently moist condition to grow taro. Though sunken and constituting a potential pond, its essential purpose is not to impound water, but to lower the surface of the field to a point nearer the ground water table. Such a pit field appears to be a sort of reverse terracing, for such fields are generally quite level spaces in the midst of dry fields on rolling to irregular surfaces. There is some evidence that at one time some taro pits were sequentially arranged, but this was not everywhere the case, and the patterns of such fields have deteriorated in recent centuries.[14] It is unclear whether the taro-pit is a marginal form of terracing, or whether it belongs at all within the wider concept of terracing. Since it does create an element of an artificial landscape, the taro-pit is included here as a suggestion that it may be within or related to the essential concepts of terracing as a procedure modifying natural land surfaces in developing cropping surfaces.

The traditional wet field often is used to grow taro on the mainland of southeastern Asia, in the Philippines, and in the Indies, but the sunken taro-pit is found only occasionally on the mainland. The regional distribution of the taro-pit properly belongs to the Islands of the open Pacific Ocean, but its full distribution is little reported.[15]

The above sections set forth various portions of a hierarchy of terracing, with some suggestions as to genetic relationships, but we are by no means convinced of the completeness, accuracy, or the order of relationships. The scarcity of critical examination of terracing as a technological complex, and the lack of distributional data on the varied forms precludes definitive classification at this writing. It seems to us that for true terracing, channel-bottom, weir terracing is elementary and a possible starting point for at least one portion of terracing, and that the narrow channel, barrage terrace is a second-step, or third-step, form evolved and adapted for use in arid lands of marked relief. The isolated, short, sloping dry field terrace appears to be a transitional form, perhaps a starting point for the full-scale development of the linear sloping, dry field terrace systems. Full scale wet field terracing is technologically highly advanced, and it appears to be a late development, but exactly where other terrace forms fit in, and how many there may be, remains to be proven.

[14] Murphy (1950): 62-6, illustrates present Micronesian usage. Skottsburg (1920): 13, mentions pit fields for growing bananas on Easter Island, but the relation of these to the taro-pit field is uncertain; Metraux (1957): 63-4, emphasises their role of providing shelter from cold sea winds for plants such as banana and taro.

[15] Little attention has been given to taro fields technologically. Hocart (1929): 107, typically comments on two former methods of growing taro, one of which involved pits; Brown (1927): Vol. 1, 145, remarks on taro pits ten feet deep to get at available moisture, but says nothing more about them. Many authors who mention taro make no comment on the fields.

It is clear that elementary terracing of any particular type may be done by a particular people long after the technological style originated, for there is ample illustration of all degrees of understanding and execution of different forms of terracing within the recent historical period. It is obvious that the origins of terracing lie far back in time, but terraces present less dramatic and less potentially productive sites for archaeological digs than do settlement sites, so that there has been little attempt to date terracing. There is little by which terracing can be dated, using the traditional techniques, and succeeding peoples repeatedly have taken over the terraced landscapes of their predecessors. Perhaps it might be possible by some of the newer dating procedures to find materials that could be subjected to date determinations, even in terraces.

We have made our suggestions of terrace types as specifically as possible in the hope that field observers will examine terraces and terracing, the better to map their distributions, typologies, and technologies. It is not to be expected that terracing everywhere will fit precisely into the patterns of the major types presented, for terraces must be tailored to their physical landscapes, and must be adapted to their rainfall regimes; there undoubtedly are terraces whose purposes cross the lines between types, and whose execution falls short of the technology required for a particular style.

THE CONSTRUCTION OF WEIRS, BARRAGES, WALLS, AND BUNDS, AND THE TERRACE FILLING TECHNIQUES

In the building of terracing the purpose of the terrace and the kind of site chosen are critically important. The 'style' of the retaining medium, weir, barrage, wall, or bund is the critical element if terracing is to be effective and permanent. Though incipient terracing may use almost any kind of material in the obstruction behind which the fill accumulates, it appears that there are only two primary kinds of materials used in the building of true terrace embankments, stone and earth.[16] A third general situation does exist, in which the country

[16] Best (1925): 117, quoting E. J. Wakefield, *Adventure in New Zealand*, Christchurch, 1908, describes log-embanked terraces supported by large pegs; Barrau (1958): 41-2, mentions both tree trunks and vertical lines of sticks being used; Brass (1941): 565-8, comments that logs sometimes are used on newly cleared land, later being replaced by stone; Pant (1935): 91, mentions the occasional use of logs. The first three pertain to the Pacific, the fourth to the Himalayas; it is likely that the use of wood was related to shifting cultivation and to incipient terracing originally, being occasionally employed after true terracing was learned. We have not found log embankment mentioned as employed anywhere with advanced and complex terracing technologies, and consider it an elementary and occasional feature.

matrix of the regolith is firm enough that terraces can be carved out of material *in situ,* but this is a special case permitting the more rapid expansion of established terrace patterns rather than a case related to the genetic evolution of terracing. At least we think, at present, that this is so — a situation taken advantage of when the technology had already become established and mastered.

The most common material used in building embankments for terracing the world around is stone, laid in dry-wall construction.[17] In its most common form the dry-wall is a wall in which stones are laid without mortar, involving a variable amount of fitting blocks, boulders, and stones together to form a strong embankment. When working in slates and other rectangularly fractured stone, no working of the stone is required, since simple sorting of slabs can find those producing sufficient fit to produce the desired result. With stone not naturally rectangularly fractured, some working is required. This may amount to knocking off projecting corners, splitting large blocks, chipping edges, and so on, to produce slab-units. In very early work this must have been crudely done, but the refinement of stone working among many peoples is an old technique, and the art of stone working has widely diffused over the world.[18] Refinement of dry-wall techniques can, of course, develop a high degree of exactitude, with precise cutting, matching, fitting, and smoothing of stone faces, even for terrace embankment construction. Normally embankments are built with some degree of batter, or rearward slope, the degree of batter depending upon the height of the embankment, and the amount of working given the rough stone. The filling immediately behind the face-wall often finds a second row of stones, or the small stone, the chipped-off fragments, and the general rubble used to chink the holes left by the primary blocks.

It is the durable stone dry-wall, skilfully fashioned, that today preserves so much of the terracing that has been done throughout the world, creating permanently modified physical landscapes. There must have been considerable early development of terracing, somewhat in-

[17] There are scattered reports, such as that of Helfitz (1958): 159-60, referring to wall terracing in which mortar is used to bind the stones. Current repairs are to traditional terracing, inferring the continuation of an old technique; in other references to the use of mortar in embankments there is often the suspicion that it is modern only. The distribution of mortared terracing of the traditional sort is poorly reported.

[18] Perry (1915): 15-7. There is repeated inference as to the correlation of the distribution of stone-embanked cultivation terraces with that of megalithic stone work in general, as in Beyer (1955): 387-98. Whether this relationship is direct, indirect, coincidental, or a result of incomplete and faulty mapping, still is impossible to conclude. Is it possible that the correlation is one of convergence, one complementing the other once the two technologies became associated?

Fig. 3. The detail of a dry-wall terrace embankment for a linear contour, irrigated terrace running across the photo, with the sloping surface of another visible in background, planted to grapes. Slopes of Mt. Lebanon, above Beirut, Lebanon.

Photo: G. A. Hale

Fig. 4. Linear sloping, dryfield terraces. No terraces currently in annual crop. Background terraces planted to olives. Slopes of Mt. Lebanon, southeast of Beirut, Lebanon.

Photo: G. A. Hale

cipient in nature, that was done prior to, or without, the use of stone, or without the technique of good construction of the dry-wall, that has not been effectively preserved. Presumably much of this has been rebuilt or has disappeared, and no longer remains as terracing at all. In most of the Middle East, the Mediterranean Basin, northern Europe, and eastern Africa, and in a major share of the New World, terracing is almost synonymous with stone embankments. Eastward across Asia the tradition of terracing with stone embankments is found very widely, extending out into the Pacific, but not all east Asian terracing employs stone as the retaining medium.

It is likely that embankments of stone at first were both crudely fashioned and low in height, and were executed on relatively slight slopes. As experience and skill accumulated the heights of embankments increased, and slopes with higher gradients could be tackled. The narrowing width of the terrace has a relationship to the height of the wall, modified by the skill of the fashioner in laying the stone. Primitive engineering practice seems early to have worked out effective solutions to the problems of weight of fill, width of terrace, height of embankment, and degree of batter given the wall, so as to produce sound and permanent construction. Excessive terrace widths, or excessive heights of embankments, involve larger and larger amounts of fill material and volumes of stone, markedly increasing the problems of engineering the construction. But economic considerations must also have entered, involving the labour costs of providing fill and stone. No standard solutions for these problems appear to have resulted, but rule-of-thumb patterns appear in various parts of the world. East African terraces appear narrow and not generally very high, though stone work in fortifications reaches impressive heights and volumes. [19] Among the north Luzon terracers of the Philippines, on the other hand, heights of embankments are impressive, sometimes with exceedingly narrow terraces, and in the Andean New World occasional fine stone work produced both high embankments and narrow terraces. [20] Much of the Himalayan hill country terracing uses only very crude stone techniques, with little working of stone, and exhibits very little engineering skill, still achieving a specific kind of purpose. [21]

In areas having marked dry seasons terrace embankment literally necessitates the employment of stone to achieve permanent construction. No vegetative materials, and no employment of earth alone, can give permanence, though for strictly temporary expedients in repairing

[19] See repeated references in chapters on East Africa in Davidson (1959) and Murdoch (1959).

[20] For the Philippines this is based on personal observation and inspection by the senior author; for the Andes see Swanson (1955): 125-6.

[21] Pant (1935): 90-4.

breaks almost anything will serve. The drying out of soil, and its vulnerability to erosion when dry and bare, requires the employment of stone to achieve permanent construction. In perennially humid regions, purposeful compaction of soil and the use of turf-forming grasses does permit the use of earth embankments, but these appear to be a late development rather than a technique going with terrace origination.

What appears to be some of the oldest of eastern Asian terracing employs the stone embankment built in the same manner as in the Middle East. But as the wet field terrace concept evolved, it would appear, the growth of turf and sod-forming short grasses, as unwanted weed growth around terrace margins, presented an alternative to embankment building. The use of the mud embankment for the wet field has been the most common accompaniment of eastern Asian terracing. Just how long this development took is not at all clear. It is clear, however, that wherever physically possible late East Asian wet field terracing has normally employed the mud embankment covered with growing sod grasses, and uses stone only where earth will not withstand pressures of weight and erosion. That wet field terrace bunds could be built of simple earth, allowing the spread of sod-forming grasses as surface-binder, enormously cheapened the costs of construction of wet field terracing, and decreased the order of skills required of the builders. Once the procedure became well developed, wet field terracing could spread rapidly over valley floors and on to any lands covered thickly with a mantle of weathered soil material.

In the wet field terrace systems developed in recent centuries among most of the rice growing peoples it has been traditional to build mud embankments into desired shapes, to permit the natural spread of sod-forming short grasses over the upper surfaces of the bunds, and to create a permanent cover which is never removed. Even in areas with fairly marked dry seasons, and in areas in which growth stops owing to cold weather, the sod remains in place as a binder, the moisture of the fields being sufficient to promote year-round growth or to keep the grasses alive. The grazing of such covers by domestic animals keeps them clean and, secondarily, provides a source of forage for the animals. In critical areas the use of stone has continued, and in many a local terrace system there may be a few spots requiring the use of stone work. In general such stone work is expedient, and seldom approaches the techniques, styles, or skills of the true-dry-wall. Not all east Asiatic rice growing peoples have taken to the newer technique, and a few still construct stone embankments in the classical manner. [22]

[22] North Luzon tribal peoples are the outstanding example. Even today the Ifugao, in the few terraces they still build, employ the classical dry-wall stone bund, carefully engineered to specific steep-sloped sites.

The filling of formally constructed terraces involves two different procedures. The first is controlled sedimentation behind embankments by using the natural flow of water, and the second involves digging, piling, and carrying of earth. We cannot, today, be certain just how widely the first method may have been employed in the past in certain areas. Use of the first technique depends upon capitalising upon natural runoff and natural sediment load in streams. What is termed *'seil* irrigation,' or floodwater irrigation, in parts of the Middle East demonstrates the technique employed in the development of one order of terracing though the technique may be conducted without achieving true terraces. [23]

Seil irrigation, when combined with a simple check dam, achieves the first of our purposes for terracing (procedure (a), p. 4), and could be the technology basically involved in the creation of our first type of terracing, 1 and (1). It is essentially this technique which was employed in the building of the narrow channel, barrage terrace, 2 and (2). At least in the Negev and related areas, there appeared the techniques of exposing the soil surface to erosive forces of rain and sheet wash to increase the transport of fill, the more rapidly to create the terrace fill. [24] We are unable to suggest how much more widely these techniques were applied, but it is likely that they were applied in other areas. [25]

The filling of terraces by direct human action appears the more commonly used filling process. In areas bearing thick mantles of regolith, filling was no doubt accomplished by back-slope digging and fore-slope filling to considerable degree, perhaps even with saving of surface soils for terrace capping. [26] However, in localities possessing only thin mantles of regolith, terrace filling requires gathering of fill material from extended surfaces of any and all nearby localities. Very widespread is the practice of carrying soil materials from stream bottoms to upland terraces. Some recent Ifugao terracers, in northern Luzon, have gathered soil by the basketful from a radius of several hundred yards above and below the terrace to be filled, with rough sorting of materials as the filling proceeds, so that surface soil caps the field surface. [27]

The replenishment of terrace fill is a normal element of continued

[23] For a discussion of the origins of terracing technology see below pp. 25-30.

[24] Rim (1954): 268; Evenari and Koller (1956): 43-4; Kedar (1957A): 186; Kedar (1957B): 184-5; one of these techniques is discussed further in the next section on auxiliary devices.

[25] See footnote [47] for comment on the possible New World occurrence of controlled sedimentation.

[26] See also the later comment on the filling of terraces by plowing on the strip lynchets of northwestern Europe.

[27] Personally observed by the senior author.

cropping activities on terraced landscapes.[28] The settling of new fill often requires a later supplementation by added material. The occasional small washout, or the more serious storm flood washout, all require the laborious refilling of terraced fields, and may involve the gathering of soil materials from some distance. Where thick mantles of regolith are present under the terrace series, the local excavation of materials may occur, but on rough surfaces with little weathered material available the painful carrying of soil upward from stream bottoms, or from long distances, becomes required.

The replenishment of the embankment stone must also be done in environments in which field stone decomposes. In established terrace landscapes this sometimes involves considerable transport, since finished terrace landscapes often contain no remaining loose stones on the surface.[29]

TECHNOLOGICAL DEVICES AUXILIARY TO TERRACING

Almost everywhere that terrace systems have been built there are employed a variety of technological devices not properly a part of terracing itself, but significantly auxiliary to the success of the particular terrace system. There are many such auxiliary features, and we comment on those that have come to our notice so far. The distribution of many auxiliary features is little reported, and further consideration of them is necessary for a fuller understanding of the whole of the concept of terracing.

In the Near East on the bare upland slopes, often just above the top-most terraces, there occur piles of rocks and pebbles, scattered at intervals.[30] These in some areas suggest piles of wall-rock gathered for another terrace wall, but somehow left unfinished. In some areas this may actually have been the case, but in other areas such piles of stone are thought merely to be the excess stone removed from, or excluded from, the terrace fill material. There is even the thought that in some cases the rock piles were purposefully placed where they are to break up the sheet flow of water on to the upper terraces in times of exceptional precipitation. Piles of stone around the roots of living trees are found, and heaps of pebbles occur around grape vines, to reduce erosion, to aid downward percolation of rain water,

[28] Bury (1915): 104, and Semple (1911): 457, comment respectively on the replenishment of terrace soils in Yemen and on many of the Mediterranean islands.

[29] Beyer (1955): 391-2, remarks on the replacement of site-derived soft stone in the Ifugao wet field bunds by hard waterworn cobblestone transported as needed from stream bottoms to upland terrace sites.

[30] Zohary (1954): 24-5.

and to serve as an evaporation-reducing mulch. It may be that some of the piles now occurring on unplanted surfaces served this latter function at an earlier time when trees and vines may have been part of a cropping sequence. In the very arid areas on the other hand, such as the Negev, the piles of pebbles were caused by the efforts to expose erodable materials to the action of the irregular rains, to assist the removal and transport to fill materials for terraces situated lower down on the flow channels.[31] Thus such stone piles may not be a part of terracing itself, but are expressions of techniques auxiliary to terracing as such.

In dry field terracing in parts of China, on upland situations of fairly marked relief, there often occur small basins below terrace levels, located at points where surface flow of precipitation runoff became concentrated. These basins appear to function as miniature settling basins, breaking up the channelled flow into rivulets that emerge from the basins in all directions, thus preventing gully erosion that would threaten destruction of the terrace series. Sediment accumulated in such basins is periodically removed and used to maintain terrace surfaces.

All wet field terracers face the problems of deficit and surplus water at varying points in a long terrace system reaching far down a slope or valley.[32] Frequently, in small valley heads, terraces are built right across the natural line of drainage flow. If the original watershed, upslope, contained a small stream the volume of water may seasonally be too large for the small number of terraces at this point, and the surplus must be diverted to a point lower down the series at which additional water is needed. In such cases a new drainage channel may be created at the break in slope at the side of valley head into which the surplus may be diverted. At particular points where two series of terraces can be spread broadly over a flattened surface there may develop a deficit point. The artificial channel through a terrace system, therefore, becomes a critically important auxiliary feature. Surpluses of water at a given point must be diverted from the terrace series when bunds are built of earth only, even if turf covered, since such excessive volumes may be too great for the simple sluice openings in bunds, and may constitute sources of erosion that sometimes do sweep out sections of bunds to cause wholesale destruction to a terrace series.

In addition to the artificial channel itself, other auxiliary elements must be built into a wet terrace system. The encouragement of quiet-pools, gravel bars, rock debris, barriers, bank vegetation, and other

[31] Kedar (1957B): 184-5.

[32] The following comments are based essentially on Chinese practices as observed in the field by the senior author. Though in general they are applicable to all wet field patterns, the explicit detail of water control techniques varies from region to region.

kinds of hindrances to erosional current built-up all must be fostered along the new water channel. To facilitate taking water out of such channels, to make up for deficits on the fields, weirs, ditches, and canals are needed and, where pumping is required, access-pools and other features must be built in.

In Ceylon there has developed a system of laying out miniature runnels on the surface of wet fields, designed to direct the flow of water fully over the fields, and to prevent primary movement directly from the in-sluice to the out-sluices, with a view to erosion control.[33] The wider distribution of such a feature is not known. It is common, elsewhere, to vary the in-and-out-sluicing of water by opening and closing, and by shifting sluice openings, the better to provide full-field coverage and reduce cutting at key points. Nevertheless, it is somewhat doubtful if the Ceylon feature is truly unique.

In some local situations, adaptable to a wet field terrace series, there is inadequate water available immediately above the terrace series. Long flume systems, ditches, and canals divert water from natural sources and convey it, often circuitously, to the terrace series. Cultural stream capture, or the diversion of headwater drainage, from one drainage system to another, is spread from the Negev to Japan, and is widely used wherever supplemental water is a factor in terrace operation. Sometimes Chinese terracing is carried so far up a slope that insufficient watershed space remains above the terracing. In such cases, after the crops are harvested, the uppermost fields will be fully dammed and turned into off-season temporary reservoirs to impound water until the next planting season, thus being unavailable for such winter cropping as may be practised locally. These are not the formal terrace ponds suggested as terracing type (9), but are simple auxiliary devices. Often the terrace fields chosen for this purpose are relatively new terraces, on which the ponding of water becomes an aid to the settling and compaction of the subsoil, thus eventually improving the quality of the terrace itself.

In portions of the Middle East, hill tops are flattened off and capped by stone structures that appear to be cisterns or reservoirs, and throughout the arid zones of the Old World related features are widespread. Cisterns, *per se,* have a wide distribution also. Whether such storage facilities were used only for domestic purposes, or also served for limited irrigation is not well known. The building of large scale, true storage reservoirs of the sort being built today across major streams, appears not to be a technique practised anywhere in the

[33] The evolution and local variation in patterns of runnels is developed in a forthcoming dissertation by Gerard Foster, University of California, Los Angeles.

ancient period in North Africa, the Middle East, or Central Asia.[34] The tank appearing in the Indian landscape, though profusely built on small streams for true water storage, neither has a major-stream equivalent, nor is it common in the Middle East; perhaps the tank is a distinctive feature of the Indian realm wherein a marked rainy season was accompanied by an equally marked dry season.

There are many auxiliary devices designed to transport water, at least some of which have application to terracing of the sort calling for irrigation water. The covered stone channels of the Negev and other parts of the Near East,[35] designed to prevent evaporation and dissipation by percolation, but perhaps also designed to prevent filling by drifting silt and sand, are paralleled in many areas by particular systems of aqueducts, qanats, and other specialised devices.[36] Though all these may have served domestic purposes also, they often are auxiliary to systems of terrace agriculture. They are far more intricate, often, in the dry world where water was scarce, than in the realm of the wet field terrace, and their relationships to the irrigable terrace systems appears more complex.

In the complex evolutions of either a compound series of wet terraces, or a comparable series of contour irrigable terraces, there is an enormous amount of water-engineering that actually becomes more intricate and complex than the engineering involved in building the terraces themselves. Thus it appears true that many peoples never fully mastered the technology of building either wet field terracing systems or contour irrigable field terracing systems. Many peoples in the vicinity of the compound terrace landscapes appear only to have been able to utilise simpler versions of terracing technologies, thus never becoming able to develop agricultural systems that were as highly advanced as those of their neighbours. Here again, we may refer to the inability of such people as the Khasi to fully develop their agricultural system to the level found among associated peoples.

In areas in which too much water is available on dry field terraces at certain times, or at certain seasons of the year, the provision for drainage eventually appeared as an auxiliary device. The actual elements of drainage amount to more than a single device, and appear extremely varied in different parts of the world. Careful stone capping of walls, small spillways, stone-lined gutter drains, diversion drains, and other specific elements are involved in the technology of getting un-

[34] Bowen (1958): 70-6. The famous dam at Marib, Yemen, was not a storage dam, as is normally stated. Instead it belonged to the category of terrace type 1 and (1).

[35] Kedar (1957A): Plate 36 A.

[36] Information on Yemen conveyed to the junior author by G. B. Cressey while both were at the American University of Beirut, 1957-8. See Rowe (1946): 211, 233.

wanted water off terraced fields. Sometimes the work involved is crude, improvised as needed, and variable in location, but in other areas it is the result of skilled handling of stone, is permanent, and is highly developed from the engineering point of view.

Associated with wet field terracing in parts of eastern Asia are drainage canals auxiliary to, or replacing, natural stream courses, whose purpose is to receive the terminal water flow off the lowest terrace of a series. When this constitutes a sump, pumping devices are required to move such water to a naturally flowing channel. Such drainage works are common in many portions of the Old World below dry field terraces, both in humid and seasonally wet environments where too great accumulation of flood waters may endanger the lowest terraces. [37]

THE POSSIBLE BEGINNINGS OF TERRACING TECHNOLOGIES

No explicit suggestion has been made, so far, toward technological beginnings of terracing as agricultural procedure, and there have been given only broad aims as motivations for terracing, to which can be added the general urge toward the creation of a field surface flatter than that provided by the original landscape. Such beginnings neither emerge clearly from simple comparisons of existing terracing, nor from preliminary reconstruction of terracing technology. The simplest true terraces now observable embody an already developed technology which, it would appear, is well beyond that of the human procedures observable among the incipient terracing actions of even the simplest of contemporary agriculture. Though it does not seem possible to formulate explicit theories which lead to all the kinds of terrace developments, a few suggestions can be made toward such theory.

Among the motivations toward terracing, we have the already mentioned urge toward a flatter surface for the field. The true utility of such a flatter field would not appear very strong to many shifting cultivators, for there are reasons why many shifting cultivators prefer slopes. A flatter field, involving considerable labour, may be presumed to be of significance only to sedentary cultivators, and it is our current opinion that the incipient terracing functions associated with shifting cultivation, of themselves, did not lead to terracing. It could well be that, among some shifting cultivators, incipient terracing might be one motivation toward the evolution of sedentary cultivation, but the present operative activities among formal shifting cultivators do not seem productive in this matter.

[37] Personal communication from Louis E. Guzman indicates that broad basin bottoms in southern Mexico also show such drainage features below the lowest terraces. See also footnote 47.

One of the motivations that has apparently led to the adoption of terracing in several parts of the world is the desire to get fields above the ground water table, or above the standing water on marshy and swampy ground, on too-wet meadows, or on the waterlogged lands of valley floors. Such motivation would derive from the desire to grow grains and other crops preferring well-drained soil conditions. This is thought to have been operative in parts of Africa, [38] and in parts of southeastern Asia. It could have been an operative factor in many flooded lowlands during an earlier era. However, it is doubtful that such a motivation could have been primary to the initial origins of terracing in general.

Those who have thought that rice, as a crop plant, originated in wet and marshy areas suggest that the terrace is a device for the controlled development of the wet field culture of rice. This appears attractive, but the beginnings of technologies involved appear difficult. Theoretically, it should be possible to conceive of the stream bed, wet field, mud terrace as a first step in this direction. Secondary steps, and evolutionary elements, in this line of evolution do not appear easily formulated. [39]

A motivation leading toward the evolution of terracing, to many contemporary students of agriculture, is the desire to prevent erosion. Though many historic agriculturists must have been so motivated, it would appear that concern over soil erosion was not a truly early concern. Soil erosion, and its prevention, becomes a concern only to peoples who have long occupied a given landscape, who become gradually aware of growing scarcity of agricultural lands, who must face the task of enlarging their agricultural productivity, or who must face the task of regaining productivity in a landscape suffering from soil

[38] Summers (1952): 73.

[39] The senior author has long been concerned with such a possible line of evolution, as a part of the separate problem of the development of rice as a wet field crop, but, despite considerable field experience in the Orient, has not put in sufficient comparative field work on either subject to come to satisfactory conclusions. Today rice is grown in natural marshes, but seldom do such areas show development of the elements of water control, and seldom are modern marsh rice growers also terracers. Modern terrace systems, and dike systems, have obliterated most of the landscape modifications executed by the earliest wet rice cultivators. The development of rice as a dry or a wet crop is a thorny problem. There does seem an hiatus in our sequence: natural wet marsh; stream bed, wet field, mud terrace; dry-wall, stone bunded, wet field terrace; sod covered, mud bunded, wet field terrace, if one presumes the wet field terrace to be an eastern Asian independent invention. It is our present judgement that the natural wet marsh did not constitute the starting point for wet field terracing, and that the 'disconformity' in evolutionary sequence is present because the whole concept of terracing came into eastern Asia from outside, affording early rice grovers a markedly new approach to the whole problem of growing wet field rice.

erosion. In other words, the concern over soil erosion is a late development, and could hardly have been present in sufficient degree to account for the beginnings of terracing in the remote past.

Still another motivation possibly productive of terracing is the desire to apply water to fields that are too dry to produce crops adequately through natural precipitation or penetration of ground water. Here we approach situations in which early man, and later simpler cultures, have actually worked. It is a commonplace among anthropologists that some non-agricultural peoples do lead water to wild plant growth, out of a desire to increase the yield of edible products.[40] No real technology is required, and a simple stick can line a miniature channel along which water can flow. Early man must have done such things repeatedly and in many parts of the seasonally dry world. Among very early cultivators who tried to grow crops in the dry parts of the world there is another extremely old procedure in this line of motivation. It is the planting of sites seasonally soaked by natural flowing water, which appears to us a possible starting point for the evolution of terracing in general. In the flatter areas of the arid Middle East and North Africa irregular to periodic flash floods, known as *seil,* descend from the surrounding uplands, deeply soaking surfaces and coating them with silt. Thus an ancient tradition of crop growing in these areas, still practised, involves planting in the moist silt cover after the water has soaked away. In areas of small streams a simple check dam may be built across a stream channel to localise the coverage of water and the accumulation of silt. Bowen has commented on the above practice, stating:

> 'It is very easy to see how primitive man could logically make the next step in the development of *seil* irrigation. He put a simple earth dam across a small wadi to trap a *seil* and its silt. When the silt dried up he planted his crop . . . Perhaps much of the development after man first dammed his small wadi was accidental or a result of the original growth of his initial invention. Assuming that the wadi was small enough so that he was able to build a dam which would hold all of the *seil*, it would not be long before the area behind the dam was silted up to such an extent that the *seil* would now be above the banks of the original wadi.'

Bowen was not working with a region of terraces, and was not concerned with true terraces, but what he describes is a method of producing an artificial, flattened, field surface created by an artificial embankment that essentially is a terrace.[41] Variations in the general procedure

[40] Forde (1934): 35.

[41] Bowen (1958): 86. For a discussion of floodwater farming in the American Southwest, see Bryan (1941), particularly pp. 224-6, and the literature on the subject cited by Bryan and for a modern application of the basic principle see Bennett (1960): 60, describing how the diking of lands adjacent to intermittent, debris-filled streams is currently producing a new version of a simple terrace type.

of handling naturally flowing water still occur in parts of the Middle East, some of them currently producing effects similar to that referred to by Bowen.[42] Bowen's volume is concerned with just such effects in southern Arabia at an early date.

Before carrying the thesis forward, other possibilities leading to flattening of slopes, on which planting could occur later, must be mentioned, though some of them are not, in themselves, motivations toward the flatter cropping field. The varied simple procedures mentioned in discussing the definition of the terrace, above, need not be repeated here to include them in the possible origins. There are other operations, however, that should be mentioned. Early housing operations probably led to flattenings of slopes in many parts of the world, and associated are the flat spaces created for threshing floors, dance floors, ritual grounds, and others of this sort. The disposal of refuse among simple cultures is perfunctory, and as refuse heaps gathered around housing sites, these might have become planting sites at a later period, possibly better production resulting from the accumulated refuse. The dooryard gardens of many simpler cultures, sometimes remaining on sites abandoned for residence, afford another variation. Such accidental terracing of planting sites, however, requires some inspirational dynamics to carry it forward in purposeful evolutionary patterns.

The natural flattening of slopes, produced in nature in numerous ways, is still another possible source of terracing. Such features as stream benches, natural levees, seasonal overflow zones with their soft, moist silts, and many related conditions, long have been used as cropping sites.[43] However few artificial terraces appear to reproduce these patterns, and the sequence of evolutionary stages does not appear readily.

One last variety of development suggests itself. In several parts of northwestern Europe the strip lynchet displays many terrace-like elements, even when there is no evidence present such as the stone dry-wall embankment. We have not tried to explore the strip-lynchet literature, but it is evident that if not true terracing, the strip lynchet at least represents a relative of terracing. Probably related to early plough culture, in which the long narrow field would have been purposeful, the strip lynchet may well be a plowman's contour terrace long predating the modern machine contour terracing. The ploughman's art long has made possible the gradual net movement of earth in one direction, and the production of earth-filled breaks-in-slope through the use of the plough alone is possible by ploughing predominantly in one direction on a given surface. Since northwestern

[42] Burckhardt (1822): 348-50; Bowen (1958): 68-70.
[43] Swanson (1955): 125-6.

Europe is a humid area with turf-forming short grasses, early farmers here might have either purposefully or accidentally produced terrace effects in which the grass turf prevents erosion,[44] as in the Asiatic wet-field bund.[45] The strip lynchet, as such, could only be a late addition to terracing technology, and could not have been an origin of terracing in general.[46] It is doubtful if the earliest ploughing, in the Middle East, used the kinds of lands needing terracing, so that ploughing there would probably not have been terrace-originating.

Of the varying procedures available to early man, involving simple techniques and skills only, but with potentially evolutionary elements clearly relatable to growing numbers of people, growing power, and growing technology, it would appear to us that at least one sound evolutionary sequence of terracing can begin with *seil* irrigation. The first terraces would be little more than incipient true teraces, but the very method of producing them could, with little engineering ability, produce many of them around the margins of a given drainage basin, and could set the stage for the application of primitive technology in a purposeful way.

If a people were to conceive the dynamics of such an application and attempt it on a very small channel producing only a small flow and a small volume of silt, by working close to the mouth of the narrow channel they might have succeeded in creating a small area of fill more properly labelled a terrace than would be true for the broader, larger area lower down on a flat basin floor. If such an attempt succeeded, later flood flow would tend to be diverted to one side, off the crown of the fill. Further barricading at the margins could add to the height of the fill. Begun on a very small scale, suffering washouts, undergoing experiments, and achieving final success, a true terrace and its production technology could have resulted. Throughout the arid portions of the Middle East very simple terrace-like structures are to be found near hill margins, on the upper flats, which appear to represent the transition between a *seil*-entrapment basin and the true terrace. Having but little careful descriptive data on such structures we have not specified this as a terrace type, but some transition form must have existed between the trapping of a *seil* in a wadi and the narrow channel, barrage terrace. Louis E. Guzman, who has studied terracing

[44] Crawford (1923): 356, quoting Seebohm, *Village Community* on the role of the plough and the unploughed balks between fields in the formation of strip lynchets.

[45] Curwen (1932): 400. That in France the grass and turf is burned along the edge of an incipient break in slope, to prevent the terrace effect growing larger, is an interesting point of some significance.

[46] Pfeiffer (1956): 251, comments on the terrace-building effect of contour ploughing as dating back to the Bronze Age of Central Europe. See also Wood (1956): 12-16.

in southern Mexico, suggests that below the foothill margins of open lowlands there is evidence of a local approximation to the Old World *seil* irrigation, and that there are terrace forms closely approximating channel bottom, weir terracing and narrow channel, barrage terracing, as well as the higher forms of dry field and irrigable dry field terracing. He suggests that there appear, in small terraces now abandoned and dissected, evidence of very old low terraces, covered by younger and higher terraces produced by a second barricade. In some cases the two barricades are aligned in similar direction, but in other cases the second barricade appears set at a different angle, though directly across the later line of flow. These are rather small features, built across small drainage channels rather than across stream channels potentially having large volumes of flood water and silt. Such elementary terrace forms would appear to approximate those we suggest for the Old World. [47]

The narrow channel, barrage terrace as built by the Judeans in the Negev, is perhaps not the next literal step forward, but is several steps up the evolutionary ladder. However, it is a true terrace, in every sense of the word, and adds only dry-wall stone engineering as a technologic additive to make it operative. Once true terracing had begun, the human capacity for adapting a pattern to a local environment could well have substituted different specific aims and purposes which could have carried forward the evolution of terracing as a whole. We would by no means insist that all terracing owes its origins to *seil* irrigation, nor to a single evolutionary origin. It is rather that it dies not now seem possible to outline other specific evolutionary sequences. Critical field examination of terracing in different parts of the world may well produce other situations contributory to additional origins and evolutionary sequences.

THE GEOGRAPHICAL ORIGINS AND DISTRIBUTIONS OF TERRACING TECHNOLOGIES

It is a kind of historical commonplace to associate terracing with China, with the Mediterranean Basin and the Near East, with the Andes, and with certain other portions of the earth. This association sometimes is related to the very origins of agriculture; for example, there have been inferences that terracing and agriculture were prac-

[47] Guzman (1961): in press. An abstract, Guzman (1958): 266, contains the sentence: 'Silt-laden water was halted behind walls, permitting suspended material to settle, and creating fertile land, capable of sustained cultivation,' which indicates some phase of controlled sedimentation, though the wording is too abbreviated to define the stage of terrace development involved.

tically synonymous in China from the beginning.[48] There is little certainty, so far, in the place of origin of terracing in the first instance. There is some evidence to argue that terracing may well be of multiple origin, but it is very questionable if all the regional expressions of terracing are expressive of local origins. Rather it would appear that the basic concepts of terracing owe their origins to a relatively few regional developments, and that early concepts and technologies of terracing spread by diffusion to many of the parts of the world in which today the traditional systems of terracing are to be found. But the very multiplicity of aims for terracing, and types of terracing, suggests that secondary invention and evolution has produced widely scattered specific origins for different kinds of terrace systems.

It appears plausible, also, to suggest that the traditional styles of terracing for different specific purposes reached evolutionary and constructional maximums many centuries ago in different parts of the world.[49] It follows that certain traditions of terracing were maintained at certain technological levels by historical successions of application in equivalent situations, but it follows, equally, that in some parts of the world terracing technology has been a recessionary tradition, with many modern peoples knowing only rather simple portions of one of the terracing systems. Very evident is the fact that many current populations carry on agricultural cropping on terraced landscapes which they did not build, which they do not extend in the traditional manner, landscapes whose technological development they cannot match.

In the near-modern and modern period there are many variations in the matter of terrace building and utilisation, though in general it can be stated that the traditional terracing systems are being little expanded in today's world of high labour costs and alternative technologies. In several areas old terrace lands lie abandoned and uncultivated. Areas of old terracing today are in forest, or are in parkland used only for grazing and wood-product extraction.[50] Shifting cultivators operate over terraced landscapes obviously built for some form of sedentary cropping system. Repeatedly there has been contraction and expansion of cultivation on agricultural lands initially turned into ter-

[48] King (1911), Buxton (1929), and Granet (1930) all associate terracing with agriculture in earliest China. However, critical examination of early Chinese classics by numerous scholars has produced no reference to terracing as such; all references are to major works such as flood control, canalisation, and irrigation of flat lands. See Creel (1937A), Creel (1937B), Needham (1954), and Wittfogel (1957).

[49] Beyer (1955): 396, suggests that the maximum development of the North Luzon terraces occurred, roughly, between 500 A.D. and 1000 A.D., and that their total area has been declining.

[50] Personal observation by the junior author in some portions of Lebanon.

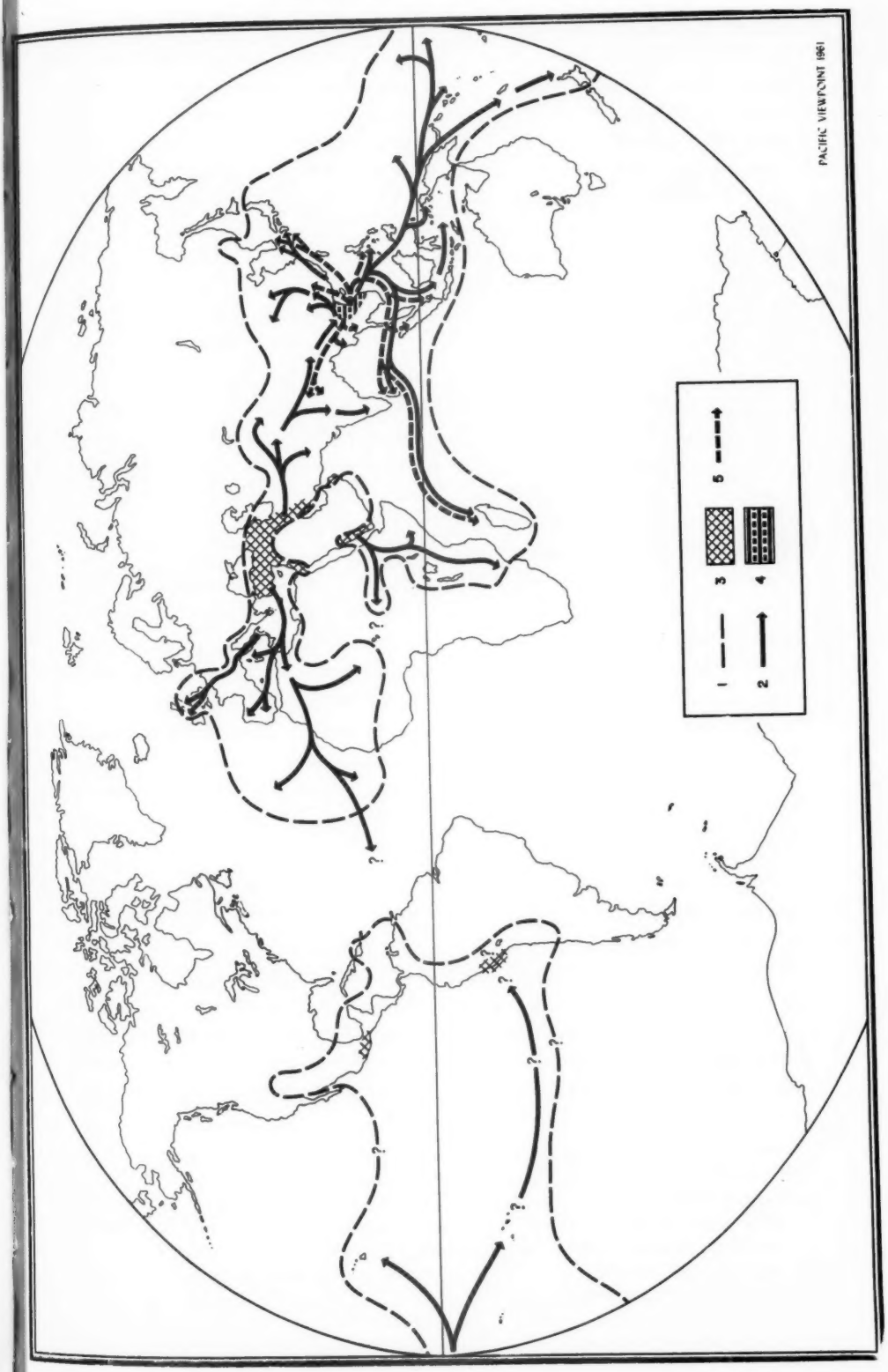
raced landscapes long ago. There is the rehabilitation of old terracing, using equivalent technologies. There is some localised new terracing in the traditional manner, filling in sections of landscapes over which the terraces never fully spread. There is removal of ancient terracing and the rebuilding of new terraces along traditional lines, employing excellent or better stone-working technologies. [51] Since we are concerned largely with traditional terracing such issues affect, to a small degree, the issue of origins of terracing types and, to a larger degree, the present distribution of traditional terracing.

The accompanying map presents tentative conclusions as to the places or origin, the routes of diffusion, the centres of secondary development, and the distribution of the traditional systems of terracing. The distribution of terracing is suggested in terms of the widest known locations, but the outer limit perhaps should be extended still further. There is no suggestion that all agricultural lands within these limits ever were terraced, and no suggestion that terracing became an integral element in every agricultural system employed by peoples who occupy the diverse regions within the outer limit of terrace distribution. [52] We stress the point that this map is highly speculative, but it does seem to answer many of the questions related to terracing systems. The basic suggestion is that the initial developments in terracing took place in any of several roughly equivalent landscape situations in the classical Near East. Reference is not to the lowlands of the great river valleys, but to the then semi-arid to arid foothill margins possessing small, intermittent streams debouching upon flat lowlands. Geographical reference is to situations located between the

[51] This process is going on today in Lebanon, with the rebuilt and new terraces being devoted to deciduous fruits, especially apples, for the export market. See Lewis (1953): 7-11.

[52] For example, though the Philippines is shown completely within the zone in which terracing was employed, the traditions of fine terracing never were used by all Filipinos, they became recessional traditions long ago, and are preserved only by the North Luzon mountain peoples. Elsewhere in the Philippines there is little terracing to be seen, much of what has been done outside North Luzon is rather elementary, and seldom has it employed water control as an efficient and integral element of terracing. The Filipino use of water in growing lowland 'wet field' rice is both elementary and incomplete in most parts of the islands. Similarly, in Great Britain, there is but little true terracing, and the tradition of terracing ceased long ago. Even the creation of strip lynchets long ago ceased to be part of the development of agricultural landscapes.

Fig. 5. Origins and Dispersal of Agricultural Terracing. 1. Outer limit of agricultural terracing 2. Dispersal of earliest terracing technologies 3. Region of origin of earliest terracing technologies 4. Region of origin of wet field terracing 5. Dispersal of wet field terracing.


PACIFIC VIEWPOINT 1961
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Arabian Sea, the Aegean-Black Seas, the Caucasus, and the Zagros Mountains. The eastern limit possibly could be placed as far east as Baluchistan but, so far, the archaelogical record east of the Zagros, in some of the basic developments around which terracing may have developed, is too incomplete to justify placing the limit so far east. The precise outer limits of our zone of origin vary somewhat according to the pattern of rainfall regimes held applicable some 9,000 to 5,000 years ago, but the key portions of the zone probably lie in the drier hill country marginal both to the flat lowlands and the naturally humid uplands. We lean toward a preference for the northern sector of this zone as the centre of origin, but cannot at present document the preference.

From this zone the several varying concepts and traditions of terracing spread out over the ancient world, undergoing evolution and tailoring to local ecologic environments and to types of landscapes as the diffusion took place. At an early date this spread encompassed the Mediterranean Basin, northeastern Africa, the eastern sector of the Middle East, penetrated eastward along the Himalayan front to coastal Indochina and, quite selectively, deep into the islands of the western Pacific. It possibly was in northern Indochina that the stone embankment described above as the wall evolved into the embankment defined as the bund, along with the reinterpretation of the application of water into the development of the wet rice terrace system. This eastern zone constituted a secondary centre of invention and evolution, out of which spread the complex wet terracing systems into southern China, Korea, Japan, the Philippines, southeastern Asia, the western portion of the Indies, back to Ceylon, and to Madagascar.[53] From Indochina the wet rice terracing system also spread westward to the Himalayan front and down into the margins of humid lowland India.

Slowly, in the Old World, terracing systems continued to spread on the margins, selectively, according to environmental requirements, The linear sloping, dry field terrace, for example, eventually was taken clear to the southern Scottish Highlands, perhaps via Roman influences, just before the start of the Christian era.[54] It continued to spread in Africa, slowly, getting south of the Sahara in the west, and creeping southward in east Africa from Ethiopia down the highland margins until possibly the 16th century.[55] In China, it spread northward and

[53] Wet field rice growing, as a complex, is now considered to be a part of Chinese culture derived from southern origins, and is merely one part of a large southern complex. See Eberhard (1950) and Needham (1954). For the Philippines see Beyer (1948): 55, and Beyer (1955): 397, and for Madagascar see Gourou (1956): 340, Murdoch (1959): 217.

[54] Curwen (1932): 404.

[55] Davidson (1959): 192 *passim*.

Fig. 6 An artist's impression of terracing in southern Honshu in the early nineteenth century: the hillocks of Lower Meguro terraced for vegetable growing, (one of the "Thirty-Six Views of Fuji", by Hokusai).

out into the northwest China. Other terrace types also spread, locally adapted, slowly or more rapidly in varied areas. In Korea and Japan, for example, the wet field terrace crept slowly northward, reaching northern Honshu only in the 17th century.

Much of the traditional terracing patterns we see today converted landscapes rather continuously, but many such landscapes are relatively recent. In China there were several eras of rapid terrace expansion, the last of which probably was the 18th century; there has been remarkable little wet field terracing done in China in the last hundred years. [56] The north Luzon terraces are thought to have been built over a period of over two thousand years, [57] and in Japan it took centuries for the present local patterns of terraces to elaborate themselves, whereas a large share of the terracing of the island of Java is a product of the 19th century. Though the wet terrace system became associated with Ceylon at an early date, much of the present wet rice

[56] See comment at footnote 2 above.
[57] Beyer (1955): 395-6.

terracing of peninsular India is 18th and 19th century development of lands formerly the realm of the shifting cultivator of sloping landscapes.[58] In Europe north of the Mediterranean much of the terracing accumulated slowly.

Admittedly there are many problems posed by the above thesis, problems that cannot be solved within existing patterns of knowledge about terracing. Perhaps the chief of these concerns New World terracing. It can be viewed as a product of Old World traditions, as a product of independent invention or, alternatively, as some combination of both. There are two possible lines of access from the Old World, each indicating a deep penetration toward the New World. One is the westward projection of dry field, wall terracing into the islands off the African coast, and the second is the eastward projection of the same tradition deep into the Pacific. However, there also are environmental situations along the Peruvian coast and in southern Mexico similar to those of the semi-arid to arid Near East, and it is possible to suggest the parallel invention of similar tradition in similar environments by peoples seeking similar ends.[59] Though much New World terracing resembles that of the Old World, there also are differences in patterns of execution, which could derive either from a totally different tradition, or from a separate path taken as evolution and maturation in terracing technologies came about. We take no position in the matter of the origin of New World terracing, since few critical studies of terracing technologies have been carried out for either hemisphere.[60]

Looking back to the general region in which we suggest the origin of Old World terracing, it is evident that not all terrace types could have had their specific origins in the same local environment. The channel bottom, weir terrace belongs to the flat lowland side of the

[58] The use and distribution of full scale wet field terracing in India south of the Himalayan front, historically, needs close examination. It is our present judgement that India has made far less use of true wet field terracing than frequently is surmised from the importance of rice as a crop. The series of irrigable fields often found along a stream valley below a tank is very old, but these often do not comprise full, true terracing.

[59] See footnote [47] above. If clearly evolutionary sequences of terracing can be documented effectively for any portion of Meso-America, the whole complex of problems around New World terracing would be altered, and there would be a sound base for considering the independent development of New World terracing.

[60] There is too great a volume of emotion clouding the issues of Old World pre-Columbian contact with the New World, and too little objective examination of critical cultural data, in addition to too little comparative study of terracing, to permit a conclusion at present.

foothill margins, whereas the narrow channel, barrage terrace belongs to the hill country itself, though both belong to country too dry for certain kinds of cropping systems. The linear sloping, dry field terrace belongs, by origin, to hill country, but to hill country having enough precipitation that cropping could depend upon natural precipitation alone. In the Near East this would have been associated with winter cropping systems. The linear contour, irrigable terrace belongs to a region having perennially flowing streams, and would seem to relate to local regions far more humid than those in which the channel bottom weir terrace was the normal development.[61] The tree-crop buttress terrace belongs to the hill country also, and perhaps its development is more expressive of conditions of relief than of rainfall regime, though it certainly is not a feature of desert environments. The last four terrace types all are associated with quite humid regions, and they could not have derived their origination from any portion of the Middle East. The last terrace form, if it does belong in terracing at all, does relate to an environmental situation in which dryness of the top soils required compensation, but taro is by nature a humid environment plant to begin with.[62]

The very nature of terrace types suggests elements of distribution preference to peoples taking up terracing as a method of furthering the development of cropping systems and agricultural landscapes. As terracing spread north of the Mediterranean fringe into the humid landscapes of northern Europe, the linear sloping, dry field terrace provided the type of field necessary under the rainfall regime and season of cropping. As wet rice has spread out of the Orient the wet field terrace was utilised. Within the Orient as wet rice has spread sloping dry field terraces have been converted into wet field terraces. As peoples have, in the past, upgraded their agricultural systems, terracing systems have altered as a complement of the agricultural system.

In a somewhat speculative article of this sort, not all of the assertions can be soundly documented. Though considerable field inspec-

[61] The highlands of the Levant and of Yemen are today regions of fairly intensive utilisation of the linear, contour irrigable terrace. Local environmental conditions in these two areas would have been favourable for the development of this kind of terrace.

[62] Obviously we have not fully explored the literature, nor does either author have personal field experience in areas in which the taro pit-field occurs. The relationship of the older form of the taro pit-field to the present taro fields located in wet spots, and to the elementary terracing of taro fields in the modern period is not well discussed in this article. There are evolutionary and sequential problems around terracing in the Pacific not brought out in our discussion.

tion of terracing lies behind the suggestions made, the suggestions put forward are highly tentative, for neither author has spent field periods specifically testing the general thesis. Though much of the regional literature has been perused, it has only been sampled, for the kind of critical study of terracing needed has never been done. It is the hope of both authors to further pursue the subject, but the subject is one that requires the critical examination of many landscapes throughout the earth for the evidence of one of man's significant forms of imprint upon the physical environment.

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Population, Land Utilisation and Possible Expansion of Cultivated Area in Nepal

PRADYUMNA P. KARAN and WILLIAM M. JENKINS, Jr.

In Nepal, as in most of monsoon Asia, population pressure on land is intense. Here, problems of land use and land tenure are of paramount importance, permeating almost every phase of the nation's economic and social life. Despite rugged terrain and relatively unproductive soils, Nepal has an average population density of over 153 persons per square mile. [1] The density per square mile of cultivated area is more than 1,300. The present population of 8,500,000 is increasing at an estimated rate of two per cent annually. As population pressure on land increases, finer adjustments must be encouraged between land use and potential productivity of the land if even the present low standard of living is to be maintained. Basic to an approach toward solving the complex agro-economic problems of Nepal is the land use inventory. There is little trustworthy data concerning the proportion of Nepal's land utilised for crops, the amount of land devoted to grazing and forests, or the exact extent of the waste and barren areas. Were this essential information collected and mapped, the planning of agricultural development in Nepal would be greatly facilitated. [2] It would also enable planners to assess more accurately the possibility of increasing the area under agriculture in order to augment the present food supply for the rapidly growing population. The distribution of land in Nepal among agricultural, grazing and forestry, and waste and barren areas and the factors which have led to this pattern are, therefore, of common concern to geographers, economists and planners. Hence some of the results of a land use inventory of Nepal such as that presented here may be a worth-while addition to the limited source material necessary for economic planning in Nepal. [3]

[1] Kumin (1958).
[2] Stamp (1958): 15; Stamp (1960).
[3] Karan (1960): 97-100.

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LAND UTILISATION

During 1957 a general land use survey was carried out in Nepal with light aircraft and a 35 mm. camera. The aero-field technique employed in this land use inventory of Nepal is described in the appendix following this paper. The land use mapping formed part of a comprehensive regional survey undertaken by the senior writer, sponsored by The Population Council, Inc., of New York and the American Philosophical Society of Philadelphia. Throughout the survey emphasis was placed on the predominant use to which the land was put. Although the pattern which emerges is considerably generalized, the map gives an accurate impression of both the amount and relative proportion of land put to different uses throughout Nepal.

Cultivated Land

The land use map (Fig. 4) reveals four major concentrations of cultivated land: (a) the sub-tropical eastern *terai;* (b) the mid-western *terai* (Figs. 3 and 5); (c) the central hill farming region extending from Katmandu Valley to Pokhara Valley; and (d) the eastern hill farming region. Widely scattered patches of cultivated land also occur in the mountain valleys of western Nepal, in the warm dry far-western *terai,* and elsewhere, but these are unimportant as compared with the four major concentrations of cultivated land noted above.

Clear delineation of Nepal's agricultural regions would seem to be a starting point for an analysis of the cultivated land. The air photos and the resulting land use map, by permitting direct observation of spacing and intensity of cultivated land, served as a basis for mapping the agricultural regions (Fig. 5). These regions were identified by drawing lines around the areas (on the land use map, (Fig. 4) having distinctive land use and farming characteristics. This categorization of agriculture is admittedly somewhat arbitrary, yet considerable air reconnaissance and mapping by the senior author in 1957 contributed to the establishment of boundaries.

The eastern *terai,* falling within the districts of Parsa, Bara, Rautahat, Sarlahi, Mahotari, Saptari and Morang, is the outstanding agricultural region of Nepal.[4] This area, which forms the northernmost extension of the Gangetic plains of Bihar (India), varies in width from 16 to 20 miles and consists mainly of alluvium which is rather gravelly in the north. This hot and humid area (Fig. 2) has an annual rainfall of more than 80 inches and is the environment of nature's dense forest and man's rice, jute and sugar cane. An extended monsoon and heavy rainfall permits the cultivation of two or three crops per year. The chief crops are those which require much water,

[4] This conclusion arrived at by the plotting of land use is substantiated by Rauch in a flight over Nepal. Rauch (1953): 317.

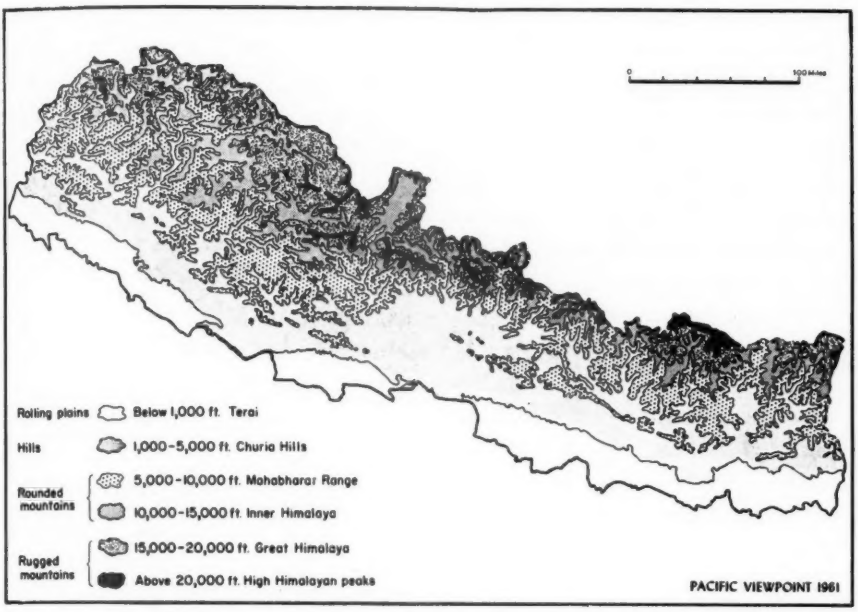

Fig. 1. Relief. Based on Survey of India, 1 inch to 4 miles map sheets.

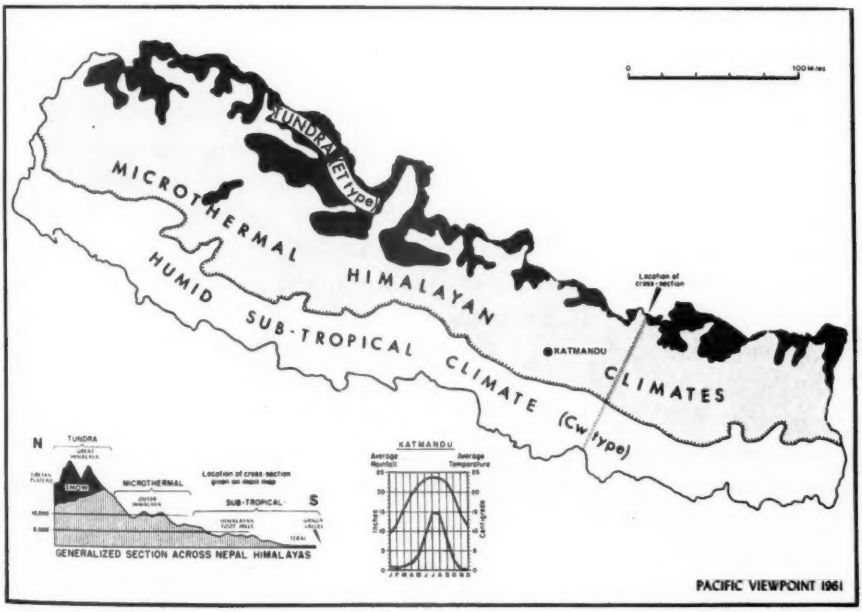

Fig. 2. Climatic regions based on vegetation. Generalised map based on field reconnaissance. Rainfall and temperature graph of Katmandu based on official data.

such as rice and jute. The region has good access to markets in India and exports sizeable agricultural surpluses of rice and jute. [5]

In the midwestern *terai,* comprising the districts of Siuraj, Khajahani, Majhkhanda and Palhi, rainfall decreases to about 40 inches and is uncertain. In this mid-western portion of the *terai* the comparative deficiency of moisture limits the intense use of cultivated lands. [6] Harvests are often poor because of the lack of rainfall. The soils and the marketing position are good but cultivation is less intensive than that of the eastern *terai.*

The portion of central Nepal extending from Katmandu Valley to Pokhara Valley, comprising the districts of Katmandu Valley, West No. 1, 2, 3 and 4 is the second most important agricultural area of Nepal. [7] Here the Mahabharat Range and the mountains of Inner Himalaya enclose several fertile valleys, including the Katmandu Valley—the heart of the country (Fig. 3). The deep alluvial soils of these well-watered valleys are extremely fertile. Both in Katmandu and Pokhara, as in other valleys of this 'central hill farming region,' agriculture is characterized by small fields, primitive implements and an intensive subsistence type of rural economy in which rice is the leading crop (Fig. 8). The hill slopes are carefully terraced. Cultivated plots in the valley bottoms are indeed small, but those on the extremely steep slopes are narrow and smaller (Fig. 10). In this densely populated part of Nepal (Fig. 6) land use is highly intensive (Fig. 4).

Within the eastern mountains (Fig. 3), which include the districts of East No. 1, 2, 3 and 4, Dhankuta and Ilam, agriculture is concentrated in mountain valleys and along terraced slopes of the Inner Himalayas (Fig. 3). Here climate changes with elevation (Fig. 2) and the region may be said to have undifferentiated microthermal climates. Although the land is rough and stony and the weather bitterly cold for much of the year, agriculture is practised by Himalayan people such as the Bhotias and Sherpas. Potatoes and barley grow in Khumu [8] (Chisankhu, East No. 3) mostly at altitudes between 8,000 and 10,000 feet; potatoes, the Sherpas' largest crop, grow at altitudes up to 14,000 feet [9] and occasionally even higher. There is a great deal of transhumance, for in the summer the Sherpas take their herds of sheep, goats and yaks to the higher mountain pastures. [10] In the lower parts the Limbus, Sunwars and Rais, who are predomin-

[5] Pant (1955): 88.
[6] Theuvenet (1953).
[7] Rauch (1953): 318.
[8] Stonor (1955): 170.
[9] Weir (1956): 103.
[10] Maillart (1955): 15.

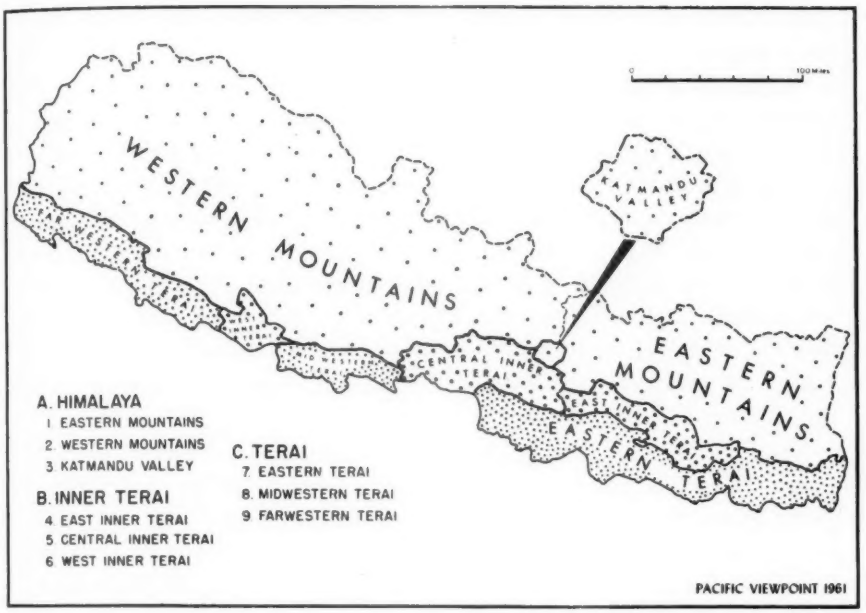

Fig. 3. Geographic regions. The regions are based on the total physical and cultural geographic expression of landscape complex. To facilitate the use of official statistics, existing district boundaries, although arbitrary in some places, have been used in delimiting one region from the other.

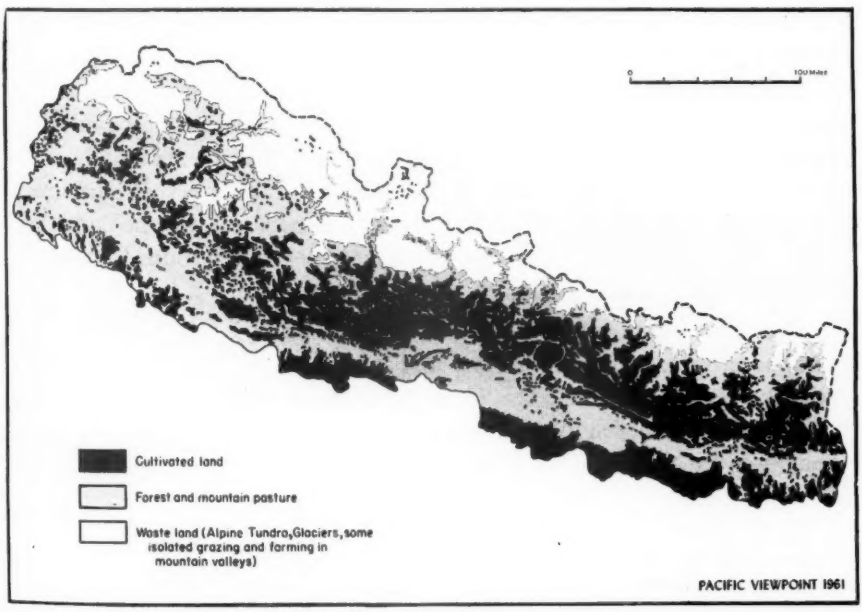

Fig. 4. Land use pattern. Map compiled from air photographs.

antly subsistence farmers, grow rice, potatoes and corn. Where there are transport facilities potatoes are exported to India. [11]

West of the Kali Gandaki River, both in the mountains and in the sub-Himalayan *terai* plains, areas of cultivated land are widely scattered with no significant concentration. This is largely due to drier conditions (estimated rainfall of about 30 inches annually) which limit the extent of cultivated land. Two agricultural areas may be distinguished in this part of West Nepal (Fig. 5) the warm-dry far western *terai* falling mostly in the districts of Banke, Bardia and Kailali, and the western hill farming region with a wide dispersal of cultivated land in various districts of West Nepal. In both of these regions the soils are moderately fertile but because of drier conditions farming is extensive[12] and population is sparse.

Lands presently under cultivation in Nepal include considerable areas which from an ecological and topographical standpoint should be under grass or forest. Contrariwise, areas in West Nepal which are well suited for farming are uncultivated because of the lack of irrigation facilities.

Grazing, Forest and Wasteland

Most of the forests [13] of Nepal are located in the foothills and the Inner Himalayan ranges (Fig. 3). In the *terai* plains proper, especially in the eastern and midwestern *terai* (Fig 3), areas under forest are comparatively small. In western Nepal more land is in forest, but much of it is unproductive because of over-felling or overgrazing (Fig. 11). Large areas have been burnt in the destructive practice of shifting agriculture.

Pasture is limited in Nepal, and forests and other uncultivated lands (Fig. 4) are closely grazed, [14] making it all but impossible to show the two forms of land use (grazing and forest) separately .The pattern is further complicated by the fact that there are scattered areas of shifting cultivation within the forests. Therefore, on the land use map (Fig. 4) grazing and forest lands have been grouped together. This area also includes strips of cultivated land.

The total pasture is insufficient for the large cattle population. [15] Fodder crops are seldom grown and cattle subsist mainly on pasture and the leaves of trees. The large number of sheep and goats places an additional burden on the available land with the result that it is heavily over-grazed. This over-grazing is one of the main causes of

[11] Rauch (1954).
[12] Rauch (1953): 319.
[13] Robbe (1954).
[14] Kihara (1955): 319.
[15] Bowers (1953): 27.

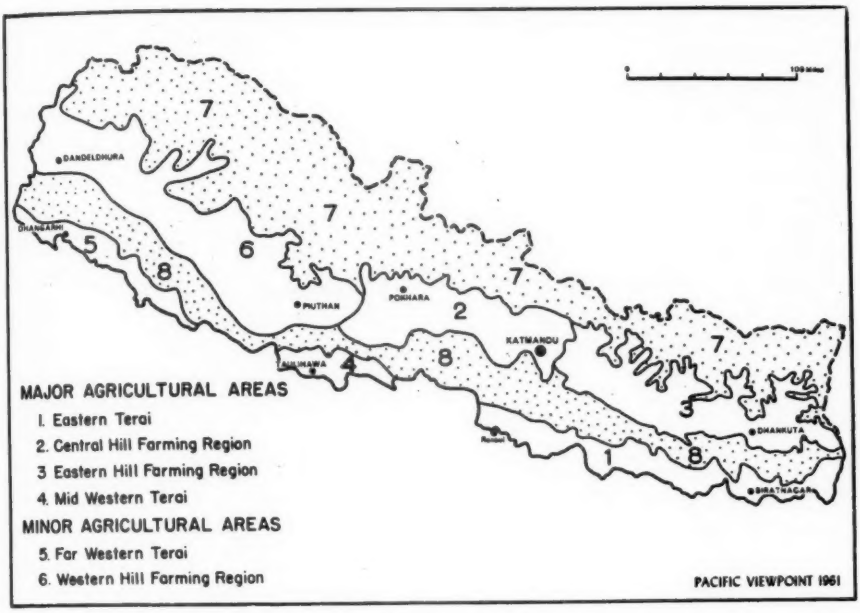

Fig. 5. Agricultural regions. Stipple indicates largely non-agricultural areas. 7. Himalayas, 8. Churia Hills.

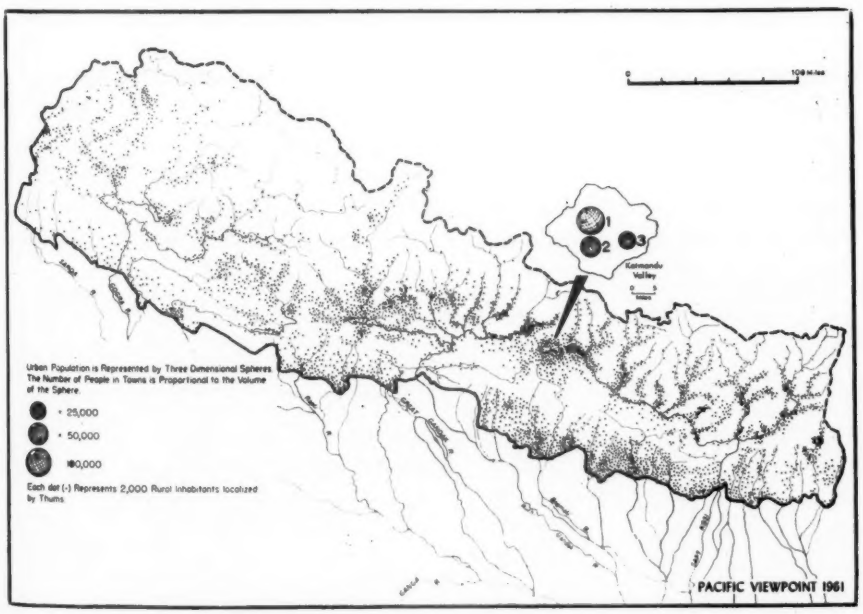

Fig. 6. Distribution of population. Based on official census data. Towns: 1, Katmandu. 2. Patan. 3. Bhatgaon.

the destruction of forest and of soil erosion in Nepal. The high Himalayan region contains good pasture, but owing to its topographical position its use for this purpose is limited.

Most of the wastelands (Fig. 4) lie in the Great Himalaya above 15,000 feet (Fig. 1). Here the climate is truly alpine tundra, with the rugged mountain ranges of the Great Himalaya rising into peaks of perpetual snow. It is practically uninhabited except for small and widely dispersed settlements in the lower parts of the mountain valleys at about 15,000 feet. Because of the rugged terrain and severe climate these lands are practically barren and useless.

POSSIBILITY OF INCREASING THE AREA UNDER CULTIVATION

At this point, when the main uses of land have been considered, it is possible to discuss the question of increasing the area under cultivation. The question is of considerable significance, as increasing the cultivated area is one of the major means (the other being increase in productivity per acre) of raising agricultural production to meet the needs of the growing population of Nepal. On this subject the writers of this paper have come to the following conclusions.

Firstly, the possibility of increasing areas under cultivation is exeremely limited in the wastelands of the Great Himalayan region because of the rugged terrain and severe climate.

Secondly, there is scope for extending cultivation to a limited extent in some of the forest areas. But against this, there are areas of cultivated land which should be retired from cultivation and brought under forests in order to afford protection from soil erosion and conserve the natural resources of soil and water. The net result would most probably be a decrease in cultivated area and not an increase. The area under forests is insufficient and has to be increased to improve physical and hydrographic conditions for controlling erosion and floods. Any decrease from the present totals cannot be contemplated.

Thirdly, there is an appreciable scope for expansion of cultivation in areas of fallow lands in the *terai*. Substantial reduction can be made in fallow lands if more intensive cropping methods are adopted and soils are fertilized, so that there is less need for keeping the land fallow. As a considerable portion of the fallow land is in the dry areas of western Nepal, extension of irrigation facilities and improvements in dry farming methods are other steps necessary for reducing the acreage of fallow lands.

Fourthly, there is scope for expanding the cultivated area by land reclamation projects in the marshy and swampy areas of the *terai,* and by large-scale irrigation projects in the dry areas of western Nepal. The precise figure of additional areas available for cultivation by such

Photo: P. P. Karan

Fig. 7. Intensive agriculture typical of the mountain valleys in Central Nepal. Contiguous cultivated fields (some of them flooded) cover most of this narrow east-west valley; woods on the mountain slopes at the top of the picture.

Fig. 8. Terraced agricultural land ten miles south of Katmandu. The west lower terraces are used for rice and the drier upper terraces grow corn.

Photo: P. P. Karan

reclamation and irrigation projects can be determined by detailed land capability surveys. But it is quite clear that the total, whatever it might be, cannot be more than a fraction of the area already under cultivation. It would be reasonable to conclude from this land use reconnaissance that the possibility of expanding the agricultural area is extremely limited in Nepal. Farmers in Nepal have pushed the limits of cultivation as far as they could with the technological means and resources at their command. If certain cultivable lands remain uncultivated, it is mainly because they suffer from serious defects like deficiency of moisture or prevalence of malaria which, though they can be corrected with modern techniques, could not be tackled with the limited resources and rather primitive techniques of the Nepalese farmer.

CONCLUSIONS

The general land use mapping of Nepal by aero-field technique indicates that increases in Nepalese agricultural production to meet the requirements of her expanding population have to come mainly through increased production (or higher yields) from the lands already under cultivation. Higher yields from the present cultivated land can come through measures like the development of irrigation, use of improved seeds, application of manures and fertilizers, proper crop rotation, control of pests and plant diseases, and the whole range of agricultural improvement practices. These measures for increasing agricultural production involve widespread instruction of the Nepalese farmers in the use of scientific techniques of agriculture and rural development.

Increase in agricultural production resulting from expanding the area under cultivation (for example, by reclamation of lands in *terai* drainage schemes) will be limited because the additional areas which can be brought under cultivation are comparatively small. The pressure of growing population in Nepal has operated to bring under use nearly all cultivable land, including steep hillsides. Small areas can be brought under cultivation by modern engineering techniques of land reclamation which are beyond the limited resources of the Nepalese.

APPENDIX

THE LAND USE SURVEY OF NEPAL

The general technique of land use mapping has been to make detailed on-the-ground field surveys to plot information on the use of land for agricultural or other purposes on large-scale maps or an air photograph base.[16] The land utilization survey of 24-Parganas[17] (Bengal), Puerto

[16] Davis (1954): 507-16.
[17] Chatterjee (1946).

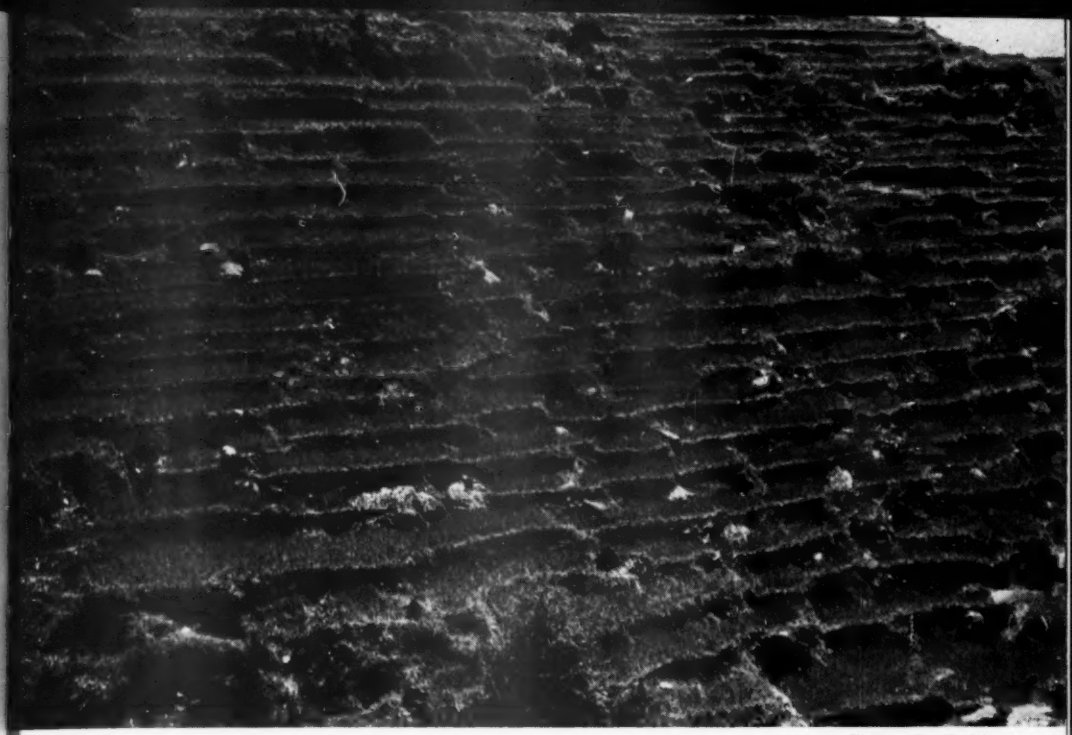

Photo: P. P. Karan

Fig. 9. Terraced fields on steep slopes are very small. These painstakingly terraced hill slopes reflect the pressure of population on available land. Near Gurkha in the central hill farming region.

Fig. 10. Dwarf peasant holding in Katmandu Valley; too small to utilize fully the labour potential of the household and inadequate for family maintenance.

Photo: P. P. Karan

Rico,[18] the Tennessee Valley,[19] and numerous land use studies of small areas in inter-tropical Asia and Africa[20] are examples of such land use mapping by ground survey methods. Land use can now be mapped directly from vertical air photos wherever available[21]. The recent land use survey of Cyprus[22] and parts of the Indus Valley in Pakistan[23] (with the technical aid of Canada under the Colombo Plan) are examples of direct land use mapping from vertical air photographs. However, in many parts of Asia and other underdeveloped areas of the world such aerial photographs are not available,[24] and this results in excessively heavy demands both on the time and effort of the geographer in land use inventory by ground survey methods. Especially in areas of rugged terrain, such as Nepal, on-the-ground mapping of land use becomes an exceedingly difficult and tedious task for the geographer.

In Nepal the physical conditions combined with the unavailability of vertical air photographs necessitated a different technique for land use mapping involving the use of low-oblique photographs taken from light aircraft with a 35 mm. camera held in the hand. This form of survey, originally developed by MacFadden,[25] was successfully employed in the land use inventory of Nepal. From the low-oblique 35 mm. colour slides a land utilization map was prepared by the senior writer in six weeks time with the assistance of two graduate students of the Department of Geography, University of Kentucky. A similar

[18] Northwestern University (1952).

[19] Hudson (1935).

[20] Results of several small-scale land use mapping projects in South Asia have been reported in the *Oriental Geographer* (Dacca), *National Geographical Journal of India* (Banares), *Punjab Geographical Review* (Lahore), *Geographical Review of India* (Calcutta), and *Malayan Journal of Tropical Geography* (Singapore). Space will permit only a partial listing of the significant recent studies in Asia and Africa: *Bombay Geographical Magazine*: Land Use Special, VI-VII, 1, September 1959, Bombay Geographical Association, Bombay, 112 pages; R. P. Moss, 'Land Use Mapping in Tropical Africa,' *The Nigerian Geographical Journal*, 3, 1, December 1959, pp. 8-17; B. Christopher, 'Land Use in the Border, Eastern Cape Province,' *Erdkunde*, XIV, 3, August 1960, pp. 195-204; D. Williamson, 'Land Use Surveys at Bunumbu (Sierra Leone), and Cape Coast (Ghana), *Bulletin of the Ghana Geographical Association*, 5, 1, January 1960, pp. 13-20; Thomas R. Tregear, *'Land Use in Hong Kong and the New Territories,'* Hong Kong University Press, 1958; R. Wikkramatileke, 'Problems of Land Use Mapping in the Tropics: An Example from Ceylon,' *Geography*, 44, 2, 1959, pp. 79-95.

[21] Rawson (1957): 60-3.

[22] Christodoulou (1960).

[23] Hodges (1960): 96-105.

[24] Stone (1959): 2-6.

[25] MacFadden (1949): 188-200.

Photo: P. P. Karan

Fig. 11. Over-grazed forest lands in the Mahabharat Range. Branches of trees are cut for fuel and fodder.

Fig. 12. A Rai village above the Arun river, east Nepal.

Photo: Peter Webster

map prepared by ground survey methods would have occupied the same team for many months of field work. In view of the need for land utilization maps of inter-tropical areas it is believed that the methods applied in Nepal would yield useful and rapid results in other underdeveloped areas. Therefore, the requirements for this form of survey, and stages by which the land use map can be prepared, are described below with special reference to Nepal.

Preliminary Aerial Reconnaissance and Formulation of Field Plan

The first step is a comprehensive aerial reconnaissance of the region to be mapped. This gives the geographer an over-all view of the area to be photographed, aids in the formulation of an effective field plan or schedule, and helps in determining the scheme of land use classification in the survey and the degree of generalization to be used in mapping.

For purposes of reconnaissance (and later land use mapping by photography) Nepal was divided into 28 major rectangular units, each unit enclosing one degree of latitude and longitude and covered by a topographical sheet (1:253,440 or 1 inch to 4 miles).[26] Each of these major units were further sub-divided into four smaller rectangular units, each division enclosing an area lying between 30 minutes of latitude and longitude. This resulted in a mosaic of 75 small rectangular units covering the entire area of Nepal. (Some of these units near the border covered only a portion of Nepal.) These smaller divisions were marked on topographical sheets (1:253,440) in advance and served as basic units for photography and land use mapping. The area covered by the small rectangular unit was first identified on the base map as accurately as possible before low-oblique aerial photographs were taken.

It is essential to make notes, sketches, cross-sections and field diagrams of the area to be photographed, and key these to the base map for purposes of later identification. The identification of areas during reconnaissance for photography is a critical problem. Much experience is needed to identify areas and key them to the base map. The success of the land use survey depends to a great extent on the successful identification of areas during, and after, flights when transferring details of land use from the colour slides on to the base map.

Aircraft, Camera, Film and Photography

Light aircraft (such as the Tiger Moth which we used in this study of Nepal) having slow cruising speed, stability, wide-angle

[26] The quarter inch (1 inch to 4 miles) topographical sheets of Nepal (based on reconnaissance survey of 1924-6) published by the Survey of India, are the only maps available. These were used as base maps for plotting land use from the colour transparency slides. The following 28 sheets cover all of Nepal: 63 E, 63 I, 63 M, 72 A, 72 E, 72 I, 72 M, 78 A, 72 B, 72 F, 72 J, 72 N, 78 B, 62 B, 62 F, 62 J, 62 C, 62 G, 62 K, 62 O, 62 P, 62 D, 62 H, 62 L, 71 C, 71 D, 71 H, 71 L.

Photo: Peter Webster

Fig. 13. Rice terraces in the foothills. Nepalese settlers in southwest Sikkim.

Fig. 14. Rice terraces and orange groves on the margin of cultivation in an area of dispersed settlement. Nepalese settlers in southwest Sikkim.

Photo: Peter Webster

ground visibility and ease of operation, are excellent for this type of land use inventory. The field geographer can fly solo and observe, sketch-map or take pictures at the same time. In the extensive land use inventory of Nepal a local pilot proved valuable as guide and landscape interpreter, especially in identifying specific areas on the base map.

Flying from Katmandu and points along the Indian border the whole area of Nepal (except the barren and snow-capped Great Himalayan region) was photographed between the months of May and August. (See black and white print of the 35 mm. colour slide, Fig. 7). Eastern Nepal was photographed first in May and June because monsoon rains start early in the east, and western Nepal was covered later in July and August. Flights were made only on clear days in good sunny weather, and several days were lost because of the rains and overcast sky. Given good weather and flying conditions, a country the size of Nepal can be photographed for land use mapping in about three months if one works an average of four to five hours daily.

In order to localise the pictures taken, the area to be photographed on a particular flight was carefully located on large scale topographical base maps during advance reconnaissance. Whenever feasible, all obliques were exposed in a north direction for easier identification. Rivers, trails and other striking features in the landscape served to localise the exposure area on the base map with a high percentage of reliability.

Any ordinary 35 mm. camera which is light in weight, simple to operate, and has low film cost is suitable for aero-field work. The American-made Argus and the German-made Praktica, both equipped with focal plain shutter, were used in Nepal. Although black and white as well as colour film can be used, colour photos comprise all of those taken in Nepal. Colour film, in spite of its slow speed, gives far superior results (if exposed in bright sunlight) in recording land use than the simple black and white film on which land use features are often difficult to identify. The chief drawback of colour film is that it can be used only on clear, sunny days, but the ease of identifying land use patterns on colour film more than compensates for its demerit. Colour film offers the geographer both the advantages of details available from low altitudes and the shadings of natural colour in transfer mapping purposes. Film exposure was determined by an ordinary light metre. Fast shutter speeds, preferably 1/200 to 1/500 of a second, were used as a caution against the blurring of detail. An ultra-violet filter was used to correct the hazy conditions which are common in mountain areas.

In the intensively cultivated areas of Nepal oblique photographs made from a height of approximately 800 to 1,000 feet above mean ground level gave extensive ground cover in enough detail to map the land use pattern. If a telephoto lens is used, higher altitudes can be flown with equal or even better results. Greater detail or greater generalisation was obtained by making photographs at varying altitudes, depending upon the particular area of the country. Thus in the mountain areas, uniformly covered with dense vegetation and having little complexity of land use, photographs taken from 3,000 feet and occasionally even higher gave large ground area coverage in good detail for mapping. In other areas, such as the valleys, close-ups were necessary to map the complex land use pattern. Owing to the limited financial support of this project, large areas of barren wasteland in northern Nepal covered by alpine tundra and glaciers (Fig. 2) were not photographed.

Preparation of the Land Use Map

The 35 mm. colour transparencies obtained by the above method were arranged in order for each of the smaller rectangular units in which Nepal was divided for purposes of reconnaissance, photography, and land use mappings. Each transparency was then projected on paper, and boundaries of the several kinds of land use were sketched on it in sequence. Traces showing the land use boundaries were thus made for each of the 75 small rectangular divisions. These traces were arranged in mosaic and reduced photographically on a scale of one inch to ten miles. For publication purposes, the original land use map was greatly reduced.

This simple projection method, using an ordinary 35 mm. slide projector, was most effective in transferring land use from the colour transparencies to the maps. Only the areal distribution of cultivated, grazing, forest land, and wasteland was plotted on the land use map. Other uses of the land such as settlements and roads, although important from an economic standpoint, occupy very small areas in Nepal and therefore are not shown on the land use map. However, it is possible to project the colour slides on a large scale, and a great amount of detailed land use pattern can be plotted from them, depending upon the degree of generalisation desired.

Now the field geographer can greatly simplify and expedite the land use inventory of large areas in inaccessible and underdeveloped countries with the use of light aircraft and an ordinary 35 mm. camera as a comparatively inexpensive and versatile field tool combination. Experience in Nepal demonstrates that the tedious field survey on the ground can be largely dispensed with to map land use patterns in adequate detail for agricultural planning in underdeveloped areas.

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The Conflict of Salmon Fishing Policies in the North Pacific

JULIAN V. MINGHI

INTRODUCTION

The North Pacific Salmon Fisheries issue is one of true international proportions, involving Japan, the United States, the Soviet Union, and, to a lesser extent, Canada.

The political geographer is interested in the effects of the competing interests of nations and the differences these interests produce upon the use of natural resources. The salmon are a highly, but not completely mobile natural resource which range across existing political boundaries into areas where unambiguous spatial sovereignty is difficult to maintain. The problem this condition creates is considered in this study both from a legal and a geographical point of view. Conflicts between national salmon fishing policies have been traditionally adjusted by legal means by international treaties, generally according to the wishes of the dominant power. The aim of this paper is to present a survey of the forms, origin and background of the current salmon fishing policies and legal position of the United States and Japan. Also considered is the compatability of existing and proposed legal arrangements with the ecological realities of the salmon cycle and with the economics of salmon fishing in the North Pacific.

Traditionally, marine resources on the high seas can be utilized by all mankind, and become private property only when caught. However, the problem is more than just the conflict over the exploitation of a valuable marine resource of the North Pacific. The peculiar nature of the salmon complicates the problem further. The salmon spawns and hatches in fresh water streams. By beginning and finishing its life cycle within the boundaries of national domains it comes within the full jurisidiction of the coastal state, that is, while it is not on the high seas. Hence, for the coastal state, even the usual basic premise in disputes involving fishing outside territorial waters, that the living resources of the high seas are common to all mankind is overshadowed by property claims. This leaves even less common ground than usual among the contestants. In the dispute in question, the United States occupies the position of the coastal state, while Japan which fishes on the high seas, holds to the traditional philosophy of the freedom of the

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seas. The policy emanating from the United States position is clouded by conflicts among different private interests and government agencies, such as those between the United States Department of the Interior and the State Department, the former giving paramount importance to a policy of conservation, and the latter primarily interested in international relations.

The salmon of the North Pacific present such a complicated resource problem that the value of this study lies in the summaries and generalizations attempted which are based on the evaluation of the many factors and points of view involved. The urgency of the problem requires generalizations in the political and economic fields even if other scientific researchers cannot yet fully sanction these generalizations on the evidence presently available.

Salmon involved in the dispute in the North Pacific Ocean are spawned and hatched in Asian and American waters. The Asian-spawned salmon are mainly from Soviet Siberian streams, while the American-spawned are mainly from Alaskan streams, specifically those flowing into Bristol Bay. Because of their strong homing instinct the salmon, after three to five years on the high seas, return to their parent stream. Salmon in climbing upstream to reach the spawning grounds deteriorate in their physical state. Hence, they are of greater commercial value as they enter fresh water from salt water than at any other time thereafter. The necessary concentration of the salmon as they run towards their parent streams from the open sea renders commercial exploitations easiest at the mouths of these streams.

Commercial exploitation of salmon in Siberia and Alaska began, therefore at river mouths along the coasts. The seasonality of the salmon runs, the remoteness of these areas from markets, the high unit-weight value and the severity of the climate in winter, have given this form of economic activity some peculiar characteristics. The salmon catch, a highly perishable commodity, must be conserved to reach the market in an acceptable condition. This has led to a heavy capital investment in a large canning industry in these remote areas. The salmon run only in the summer months. Since there are few or no off-season employment opportunities, labour in the fishing and canning industries in these isolated areas migrates seasonally. Commercial salmon fishing has continued in this fashion in Bristol Bay under the direction of United States labour and industrial interests and by the Japanese, under a lot-renting system from the Russians, along the Siberian coast. Japan began high-seas fishing for salmon off Siberian waters in the early 1930s. Later in the decade, Japan entered Bristol Bay with experimental and survey vessels with alleged intent to extend large-scale salmon fishing activity to these waters in the future. After protests from the United States Government, Japan announced that she would not fish in Bristol Bay in the future, and withdrew. How-

ever, the problem of the conflict between the coastal state and the high-seas maritime nation over the exploitation of salmon had been raised for the first time in the North Pacific.

After the War, measures were taken by the United States to exclude Japan from fisheries where salmon spawned in Bristol Bay streams occur. By the terms of the Treaty of Peace, Japan was committed to enter into negotiations with other countries, and hence joined Canada and the United States as a party to the International North Pacific Fisheries Convention (I.N.P.F.C.) in 1953. In the early 1950s the only Pacific nations with active interests in commercial salmon fishing were Canada, the United States, Japan, and the U.S.S.R. Although the Soviet Union had been actively fishing salmon on an increasing scale since the 1930s, her activity was confined to coastal fishing along the Siberian coast. Added to this was the fact that the Soviet Union shared little common political interest with the other three nations. Hence, it was possible for Canada, the United States and Japan to agree on measures covering most of the North Pacific that would apply to themselves, and would theoretically exclude "newcomers" from catching salmon in convention waters. The area of the North Pacific covered by the terms of the I.N.P.F.C. is 3.2 million square miles, and contains approximately one-third of the world's fish resources.

The I.N.P.F.C. members agreed that, under certain conditions, they would abstain from catching salmon, and also halibut and herring. Hence a "piecemeal" approach to the fishery problem was adopted. The Japanese agreed not to catch salmon of North American origin, and asked if a line might be established in the North Pacific which would facilitate their complying with the agreement. Thus, on the scientific evidence available at the time, a line at 175 degrees West was established to divide the Asian and American salmon by origin, East of which the Japanese would not fish. This set up a zone contiguous to the American coast within which no parties of the Convention could fish for salmon. It has since become known as the "zone of abstention." At the time, this line was thought to divide satisfactorily American-spawned salmon from Asian-spawned. In international law there is a lack of acceptable procedures and principles for delimiting any contiguous off-shore zone of a coastal state in order to carry out an intended conservation policy. Hence, such a zone as this can only be established by mutual consent between interested parties, and can only be changed under the same terms. The view of the American fishery interests is that the "doctrine of abstention" is an outgrowth of the concept of "historic rights," which in turn is based on the notion that, by virtue of the location of the spawning grounds and the history of sole exploitation, the salmon are an American resource, and hence American property. There is no way

for fishermen to recognise the distinction between Asian and American-spawned salmon, and only lately have biologists been able to differentiate. However, the official United States' view, which is that of the State Department, is that the abstention doctrine is valid: (1) when the resource is being fully utilized and there is no waste; (2) when the resource's continued productive state is due to the research and regulations enacted by the countries exploiting the stock; and (3) when all countries presently participating in the fishery are allowed to continue to do so.

Ironically, the present conflict arises as a result of protests by the United States, the architect of the convention's measures, against the activities of Japan in assigned waters. Japan's high-seas fishing catch has been increasing and the runs in Bristol Bay have been falling. The Fish and Wildlife Service of the United States Department of the Interior has adopted a conservation policy which demands that there be a minimum escapement allowed upstream to ensure propagation of the salmon at a sustained yield level. Hence, partly due to Congressional legislation based on inadequate scientific research, catches have fallen more rapidly in Bristol Bay than they would have done, even taking into consideration the diminishing runs of salmon. The explanation of the over-all depleted stocks of salmon has yet to be found. American fishery interests think over-fishing by Japanese fishermen is largely to blame for the depletion in 1957 and 1958, in the belief that the 175 degree West line is, after all, misplaced, and does not satisfactorily divide Alaska-spawned stocks from Asian-spawned. For the explanation of the drop in the total run, however, one must go back considerably earlier. That catching of these salmon, *even* west of the abstention zone, is held to be contrary to the "spirit and intent" of the treaty. Consequently, the United States now urges that the abstention line be moved westward. The Japanese argue that the line can only be moved if conclusive scientific evidence can be produced to show that the line does not conform to the convention's intentions.

The convention obligates the signatory powers to carry out scientific research into all aspects concerned with salmon and their movements on the high seas. The results so far show that there exists a broad zone of intermingling of Asian and American-spawned salmon. There is also great variation in the size and movements of stocks of these salmon from one year to another and annually of different species of salmon. Thus, Japan argues that there is no conclusive evidence as yet, and that there will possibly never be a basis for moving the line within the terms of the convention. Obviously a time will come when two lines could be drawn based on biological evidence. One would mark the absolute eastern limit of Asian-spawned salmon, and the other the westernmost limit of American-spawned salmon. If future evi-

dence follows the trends of the findings so far, these two lines would be extremely wide apart, and would contain a number of intermingling salmon. The United States of course, would support the westernmost line, and in fact, has proposed a move westwards of 15 degrees, to 170 degrees East. Japan would use the argument for the eastward line as a counter to the United States proposal, and also as justification for not moving the line from its present position.

From the above reasoning several points arise. The inherent difficulties behind establishing a line running North and South across an ocean to divide salmon by origin can now be seen. The 175 degree West line was meant to be provisional, an administrative procedure to solve an immediate spatial fishery problem. Although this practical solution was meant as a temporary compromise at a certain point in time, inertia set in, as with any provisional line where vested interests are vitally involved on land or on water. The selection of the 175 degree West line in 1952 for the division by origin shows the fallacy of founding legislation on scant scientific evidence, rather than determining if a certain type of legislation would be effective scientifically, and if so, establishing measures accordingly. Lines of absolute limit of one origin or another could eventually be drawn, but any line in between would merely cut through the zone of intermingling. In the case under consideration it seems that in the immediate future no *one* line can be drawn on a scientific basis, whether all parties agree to the principle of equitability by origin or to one of equitability by some quantitative measure involving different species of salmon. Any such line would have to be based on many years of data collection. As with other problems in the natural sciences, there has existed a need for many years of intensive research if prediction techniques are to be developed to such a degree that a movable line, or several lines for several species, can be delimited annually. Under presently-known techniques, although there have been considerable improvements, such delimitation would be impossible.

The basic difference of opinion is not one of a scientific nature but one of attitude. Although the United States and Japan are parties to the same convention, Japan does not share the philosophy upon which the convention is based, a philosophy of abstention and equitability by origin. Japan herself however, is in no position to counter American claims with arguments using the same philosophy because the bulk of the Asian-spawned salmon, and by far the greater part of the Japanese catch on the high seas in the post-war period, is of Russian origin. Ever since the 1930s Japan has been progressively constricted in Siberian coastal regions. High-seas fishing temporarily solved this problem, although it has raised others with the United States. Now Russia is evidently also beginning to indulge in high-seas fishing

for salmon,[1] further complicating the issue, for although she is fishing largely for salmon of her own origin, she will be competing with Japan, and antagonizing the United States. She is not a member of the I.N.P.F.C. and will presumably fish exclusively under her own regulations. One thing is certain. In the words of Milton E. Brooding, spokesman for the United States National Section at the 1958 I.N.P.F.C. meeting, "Bristol Bay sockeye runs can be exterminated if both of these intensive fisheries—the Japanese high-seas fishery and the United States inshore fishery—are not adequately regulated."[2]

THE JAPANESE CASE

Background

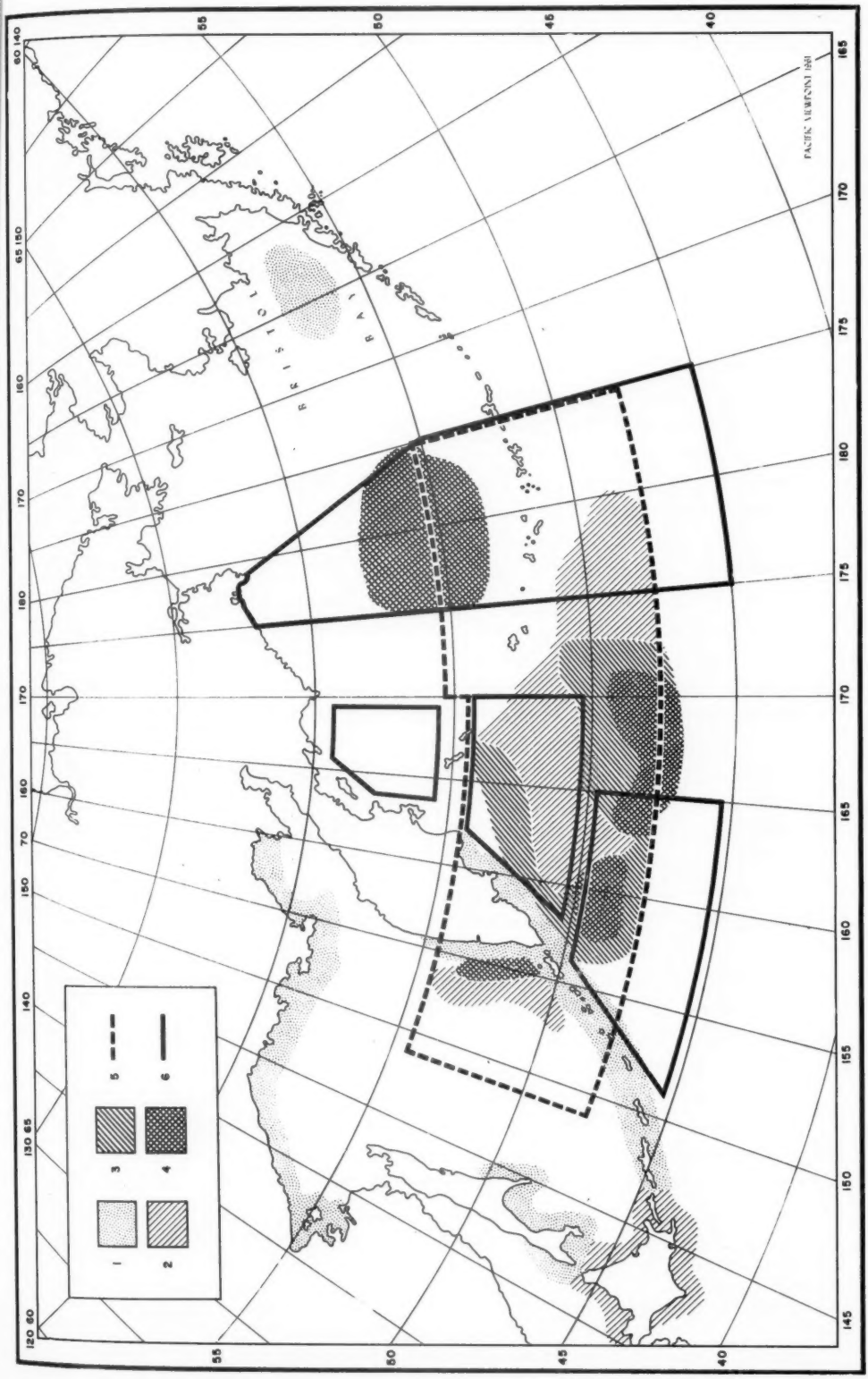
Although salmon is not of great relative importance in the total Japanese fishery economy, the great expansion of the export market is largely due to increased exportation of canned salmon to the United States, to which 45 per cent of Japan's total value of salmon exports is sent. European demand for Japanese canned salmon has also risen in the last few years.

In the period since 1930 the great feature in salmon fishing has been the increased efficiency of the mother-ship system. Catch per vessel increased tenfold during the period 1930 to 1935. Over the same period the number of catcher-ships increased at the same rate, although through technical advances the number of mother-ships needed to handle this increased productivity has merely doubled. About 90 per cent of Japan's total salmon catch comes under the realm of the mother-ship system. The vessels are equipped with such modern devices as ultra short-wave radio which allows a working radius of 35 miles from the mother-ship, fish detectors, echo-sounders, direction finders, gyro-compasses, radar and even aqua-television. The mother-ship programmes the orderly arrival and discharge of her catchers, to avoid loss of time and confusion. Ever since the resumption of this type of salmon fishing soon after the War, there has been a progressive increase in productivity due to the increase in the efficiency of effort, and to a larger North Pacific population of salmon in the immediate post-war years.

The post-war scene has been characterized by the limitation of Japanese activity in salmon fisheries under various agreements with the

[1] So far there is evidence only of research fishing. Under Soviet regulations only traps and seines are permitted. Gill nets are outlawed as injurious.
[2] I.N.P.F.C. (1959): 53.

Fig. 1. The History of Japanese Salmon Fisheries. Key: 1. Pre-War areas, 2. Post-War light catch, 3. Post-War medium catch, 4. Post-War dense catch, 5. Japanese Govt. authorised fishing area, 1954. 6. Soviet proposed fishing areas, March, 1959.


PACIFIC VIEWPOINT 1981
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U.S.S.R., and under the terms of the I.N.P.F.C. (Figs. 1 and 2). The former agreements are flexible in terms of quotas, season and location of fishing, and vary annually. By a Russo-Japanese fisheries agreement for the 1958 salmon season, Japan cut her fleet in the Okhotsk Sea by 50 per cent from the previous year, and reduced her quota from 120,000 metric tons to 110,000. On the other hand, by its very terms, the I.N.P.F.C. has been inflexible and has led to a *status quo* which has been a distinct disadvantage to the United States, the original formulator of the I.N.P.F.C. The Japanese-Soviet Fishery Convention, signed in 1956, gave the Soviet Union a good bargaining position by which to limit Japanese fishing activity still further. The Soviets were in a position to take action on unilateral decisions, whereas, by the terms of the I.N.P.F.C., the United States is not. The Soviets have cut quotas on presumption of depletion through overfishing, and as a result there has been much Japanese irritation over Soviet policy. The Fishery Convention settles no problems on a long-term basis, but resolves itself into a yearly battle in which scientific research is of little or no consideration.

In the present decade, deep-sea fishing has been a basic issue. The 1956 Fisheries Pact between Japan and the U.S.S.R. place restrictions on size of catch in the Northwest Pacific. Questions, however, were settled politically, and not scientifically. Agreements were made on scanty scientific evidence. The Soviets argued for conservation against indiscriminate fishing, and the Japanese maintained that statistical data did not support the thesis that stocks of salmon were diminishing. At a conference in Tokyo in March, 1959, the U.S.S.R. made staggering curtailment proposals for the 1959 salmon fishing season to Japan. After more than a month of discussion, the original Soviet proposal of a quota figure totalling 50,000 tons had expanded, and the Japanese demand for 160,000 tons had contracted to reach an agreed compromise quota of 94,000 tons for the 1959 season. [3]

Although these latest Soviet proposals would place severe limitations on Japanese salmon fishing, they do recognise the right, or necessity, of the Japanese high-seas operation to catch salmon which are mainly of Russian origin. There is, so far, no attempt to prohibit absolutely the catching of Russian-spawned salmon by the Japanese. In this respect the Russians differ in attitude from the Americans. The difference is basically an historic one. The Japanese were largely responsible for developing the Siberian fishery, whereas they have no historic rights whatsoever over the North American salmon. Another point raised is the possible conflict between the two treaties, the I.N.P.F.C. and the Russo-Japanese Agreement, over potentially the same waters and resource therein, and involving a member of both

[3] *Pacific Fisherman* (1959): 1

treaties, i.e., Japan. This possible conflict of regulations would seem to illustrate as unwise the conclusion of different treaties over waters which essentially form one unit in terms of high-seas fishery regulations. Of course, it can be argued that, although the high seas form a legal unity in the North Pacific, there is a division of stocks based on origin. The intermingling of these stocks during the migration period and the Japanese high-seas fishing activity in the intermingling area, serves to blurr this distinction based on origin-division. As Senator Magnuson of Washington has said, if the purpose of the I.N.P.F.C. is to conserve and perpetuate salmon resources, it "must include all four nations substantially utilizing that resource." [4]

In a way these latest Russian proposals are a continuation of the annual discussions which occur between Japan and Russia before every fishing season over salmon fishing regulations in the Northwest Pacific. However, the 1959 proposals are unique. For the first time they have considered waters up to the I.N.P.F.C. Abstention line to be "treaty" waters, and have placed limitations on them accordingly. In doing this, the U.S.S.R. has adopted the same arguments of "conservation" and "special rights" of the coastal state, as the United States had adopted to protect its interest, although the abstention philosophy of the two powers is considerably different.

The history of the I.N.P.F.C. has been equally turbulent. At the annual meetings of the convention, national policies are aired, and supported as best as possible by scientific evidence prepared by each country's research group during the previous year. Increasing catches by Japanese fleets in assigned waters have contrasted with a steady decline in the Bristol Bay runs. At the last two meetings the United States has demanded that the line of abstention be moved westwards. On the other hand Japan has seemingly made several concessions. During the 1958 season Japan agreed to restrict operations near the 175 degree West line, and also agreed to a quota. In fact the Japanese fleet did not fish east of the 170 degree East line. These promises were extracted from Japan at the threat of possible economic sanctions instigated by American industrial and labour interests. If the Pelly Bill [5] or several other similar bills were made law and enforced, the Japanese salmon canning industry would suffer a great loss of market. It is of course an open question whether the Japanese fleet stood by her promises purely as a friendly gesture, or because of the absence of fish in the vicinity.

Early in 1959, following the announcement of the closure of Bristol Bay to salmon fishing for the 1959 season, American antagon-

[4] *Pacific Fisherman* (1959): 29

[5] A bill before Congress that would ban the importation into the United States of canned salmon caught under circumstances illegal to American fishermen, i.e., all Japanese canned salmon.

ism against the Japanese developed to a degree reminiscent of the 1930s. The United States' Secretary of State has been petitioned by Pacific Northwest and Alaskan senators to bring the State Department directly into the issue, just as Cordell Hull had been petitioned over 20 years before. Threats to pass legislation which would ban the importation of Japanese salmon were renewed. On the other hand, the Japanese allege widespread misunderstanding of the causes of the depletion of Bristol Bay salmon, and deny that their high-seas fishing activity is responsible.

International Law Standing

In general terms the Japanese case rests on the traditional international law concept of the freedom of the seas. Japan is one of the staunchest supporters of the three-mile limit rule. Japan's case is centred on her attitude toward the control of the exploitation of the riches of the sea, and to the doctrines of the contiguous zone, and the coastal state.

Japan maintains that the coastal state is not allowed to claim the exclusive exploitation of natural resources under any other institution than that of the territorial sea. The Japanese distinguish between the problem of marine resources, especially the conservation of biological resources, and the problem of the contiguous zone. The doctrine of the contiguous zone cannot be interpreted to justify a monopoly of fisheries outside territorial limits, since a monopoly can be asserted only as an exercise of the right of sovereignty within an area subject to sovereignty. The maritime states, with ability and improved techniques for fishing on the high seas, will never renounce the rights of exploitation established thereon.

The area between the three-mile limit off the Alaska coast and the 175 degree West line of abstention is certainly in the "contiguous zone" class. The monopolistic connotations of abstention zones declared unilaterally by a foreign state are obvious. The suspicion and fear entertained by Japan over these declarations have been well grounded in the Kamchatka Sea, where, in 1956, a monopoly of high-class salmon fishing was set up by the unilateral action of the Soviet Union. Japan supports the traditional principle that the freedom of the seas cannot be violated by any unilateral declaration or by any new theory. Japan recognises the need for conservation, but with regulations set up by conventions between interested parties.

One of the notes, discussing the place of the coastal state in a fishery conservation programme, in the Report of the Rome Conference in 1955 states that no conservation measures should be taken by the coastal state on the high seas without international agreement. The reasoning behind this is that conservation measures are based on scientific and technical evidence, and the coastal state has not neces-

sarily got the best, let alone a monopoly of such evidence. Hence, all users should have equal rights to supply information and to formulate measures. Consequently, Japan argues that there is no reason to elevate the coastal state to a superior position. Geographical position alone is not evidence of interest or scientific knowledge about conservation. Mr Tsuruoka, a member of the Japanese delegation at Geneva in 1958, declared: "As the concept of conservation is primarily scientific, and not political or economic in nature, the coastal state should have no unilateral rights to regulate fisheries by virtue of its geographical position."[6] The argument that the coastal state is in a "special position" based on social and economic reasons is considered untenable. Such an idea could lead to abuse of foreign fishermen, and also to under-fishing. The very purpose of a non-coastal state fishing so far afield is explained by the lack of adequate resources available near home to sustain its population. To cut off non-coastal states from these distant resources would deprive a large section of the population of their present standard of living.

According to the Japanese point of view the abstention theory, which forms the basis of the I.N.P.F.C., is held invalid because it lacks a scientific base, and hence has nothing to do with conservation.[7] The main seed of controversy in the dispute hinges on the line of abstention and the "zone of intermingling." The possibilty of Asian and American salmon intermingling was realized in 1951, and the 175 degree West lines was meant to be a temporary measure. To move it, three process stages are provided under the convention: (1) scientific investigation up to a point when conclusive evidence of a discrepancy between the line, and the location and movement of salmon of different origin is available to support a shift; (2) political and diplomatic approval; *and if this fails,* (3) an impartially decided scientific line. The convention is still concerned with stage one. From the American point of view there has been some success because the Japanese have been kept west of the abstention line and away from Japan's alleged just claim of up to the three-mile limit. Japan, who has opposed the abstention principle that she feels the convention forced on her in 1951, is obviously in no mood for further concessions. Japan contends that arguments to move the line westwards are arbitrary, and based on extremely insufficient scientific data, and that to move the line *now* would be to scrap the convention. She also contends that proof is insufficient that there are large proportions of American-spawned salmon among the different species in the intermingling zone.

The freedom of the seas concept is the corner-stone of the Japanese case. In the past Japan has used this concept aggressively, but

[6] United Nations (1958): 7.
[7] United Nations (1958): 41.

now she is using it to defend her position against further loss. As a signatory to the convention she has prejudiced her position somewhat. Japan, however, has since taken a very strong position against any further extension of the abstention doctrine and the coastal state concept. She has to be very careful not to set precedents in policy in the convention, which would be detrimental to her position in other fishing disputes with other states.

At present, Japan's population has been increasing by 700,000 annually. To offset the threat of economic chaos the standard of living must be maintained and improved, and the greatest possible resource base must be sought in order that technical and organizational innovations may be fully utilized. In her effort to expand her fisheries, Japan has had to vary her policy to reach compromises in different situations. A programme suggested in 1949 for the future of Japanese fisheries proposed such measures as reorientation and improvements of fishery methods, improvement in collection and computation for production statistics, reappraisal of legislation, improved handling and transportation of fish, exchange of fishery products on the foreign market, and expansion of fishery areas.[8] Since then, under national guidance, all these measures have been carried out, but the expansion of the fishing industry has met with international complications, and Japan has only submitted to limitations on this policy when conclusive scientific evidence has shown that the fishery in question is becoming seriously depleted due to over-fishing. The high-seas salmon fishery operates under such adverse conditions as foul weather (about one-third of the days during the season are impossible for fishing) and conservation measures. There are restrictions on the length of nets, the size of mesh, as well as the distance between nets. Quantity of catch is regulated by quotas, and all fishing is prohibited after 10 August. Even given continuous good weather, the nets are down in water for a maximum of 42 hours a week. The great economic potential, flexibility, a real mobility, and high order of technological efficiency, has given the mother-ship system the greatest possibility of success. With this fact of economic success and that of heavy capitalization in the industry, the other arguments for the Japanese case, those of dependence upon exports on this high-value, low-bulk product, of protein, diet and occupational dependence are reinforced.

THE UNITED STATES CASE

Background

Salmon fishing is of only local and regional significance in the United States. It has lost much of its pre-war importance in terms of labour, taxes rendered and installed capital.

[8] Espenshade (1949): 82.

The salmon-fishing industry has formed an integral part of the regional economy of the Alaskan coast, and salmon fishing is still the most important fishing activity there in terms of value. Diminishing runs of salmon, domestic conservation legislation and foreign competition have rendered the industry unable to keep pace with the steady growth of domestic and foreign markets. Imports, principally from Japan, are annually more able to compete in the domestic market. Imports of canned salmon for 1958 showed a 25 per cent increase on those of 1957. Japan accounted for 73 per cent of the total canned salmon imports of United States. During the years of increasing catches up to the mid-1930s, the industry was characterized by the domination of a half-dozen large firms which forced the smaller firms out by their ability to lead in the pricing field and by virtue of the economies of scale and vertical integration they enjoyed. Decreasing runs of salmon have led to diseconomies of scale, to the failure to reach threshold requirements, to lower productivity and, consequently, to a finished good at rising cost. Despite this drop in economic importance the industrial and labour interests concerned continue to have a strong political voice. All the companies together have maintained for some 30 years a negotiating body, The Alaska Salmon Industry Inc., while the Alaska Fishermen's Union represents the labour interests of the seasonal workers in the salmon industry. Because of the seasonality of employment, the industry has some extra-regional importance. A large proportion of workers come from the Puget Sound area. There are few opportunities for work in the off-season. The isolation of the industry along the Alaskan coast means that the organisation centre is on Puget Sound. In fact, the capital investment and profit sharing involves many Pacific Northwest interests.

The basis and growth of the Alaskan economy has depended upon the exploitation of minerals and fish. Mining is a "robber" economy and its raw material is irreplacable. In fishing, however, a policy designed to maintain an optimum level for exploitation is thought possible. Alaskan Statehood will doubtless lead to a decrease in dependence on Federal funds, and a growing increase in the responsibility of the new state to balance its own budget. Taxes on fisheries have for some time been the chief source of Alaskan revenue, and the fisheries produce an export surplus in the balance of trade. Moveover, in terms of total value over the long run, salmon have contributed more to the economy of Alaska than all the gold mined there.

Historical Context of Salmon Fishing

The development of the industry in Alaska has been basically conditioned by the character and location of its raw material supply. As mentioned above, the peculiar characteristics of the salmon are such that the ideal time and place to catch them is at the river

mouths where they run in large schools near the surface before ascending the freshwater streams to spawn and die. Before technical advances made mass-exploitation possible on the high seas, it was most convenient and profitable to begin salmon fishing, as the Japanese had begun in Siberia, in waters close to the shore and at river mouths. It is still sounder economics to fish for salmon at the river mouths, but for obvious political reasons this is no longer possible for the Japanese.

Because of its marginal geographical situation, Bristol Bay did not come under intensive salmon fishing activity until the early years of this century. Due to its physical excellence in terms of factors controlling quality and quantity of salmon runs, it was exploited successfully with increasing returns until the late 1930s. As a result of bitter lessons learned in the past along the entire Pacific Coast, a conservation policy was adopted even in the early days of salmon fishing activity in Bristol Bay. Since early Congressional legislation in 1906 proved not particularly effective, the White Act was passed in 1924. Under the White Act the Bureau of Fisheries was given full power over all fishing in Alaska. The act provided for at least a 50 per cent escapement of all salmon entering the rivers to spawn. It was recognized that the number allowed up the river to spawn, known as the "escapement," was related to the size of the run a few years hence, and that conservation based on a "minimum escapement" policy would render a direct return in the area applied, thus initiating a principle of optimum sustained yield. This would make for a very close spatial relationship between sacrifices made, and benefits reaped.

Up to World War II, the Alaska salmon pack led the world in output. In 1935 Freeman wrote, "so far the Asiatic output has not seriously disturbed our markets." [9] Within the last decade the picture has changed considerably. Salmon runs have been steadily falling since 1935 despite the minimum escapement policy strictly adhered to by the United States Fish and Wildlife Service (F.W.S.). Catches have dropped accordingly. Techniques developed in recent years have been prohibited by law in the interests of conservation. Decisions about areas and times allowed for salmon fishing are often made during the season by the F.W.S. Federal Law forbids United States citizens taking salmon by nets on the high seas. The fish trap which, in economic terms, is the best method of catching salmon, is also forbidden. Quality is a prime requisite for success in the salmon canning industry hence the time between death and canning must be as short as possible. Fish traps are ideal for minimizing this critical period because the supply to the cannery can be stabilized by leaving the salmon alive in the traps, and removing the mat such times and in such a number as

[9] Freeman (1935): 129.

the cannery might require. The F.W.S. has chosen to legislate in this way to avoid any sudden drastic dislocation in the industry. However, a satisfactory sustained yield has not been realised, and growing inefficiency, despite some organizational changes, has been characteristic of the industry since the War.

In 1957 the situation became critical. Over-fishing by the Japanese was blamed for the drop in the Bristol Bay runs. During the 1958 season the Japanese complied with an American request to fish only a given number of salmon and, if possible, to catch them all west of 170 degrees East. Again this was not an official agreement as the Japanese were much afraid of prejudicing their chances of a satisfactory agreement with the Russians, by openly agreeing to limitation with the United States. After preliminary warnings in December, 1958, the F.W.S. decided in March 1959, that, to ensure sufficient escapement to maintain the resource, Bristol Bay would be closed to fishing for the 1959 season, although, in late May 1959 after the Japanese had agreed to reduce fishing intensity for the 1959 season, the Bureau of Commercial Fisheries announced that a limited red salmon catch would be allowed in Bristol Bay. The relationship of escapement to runs has been reasonably good, except for 1957, when the Japanese high-seas fishery for the first time operated north of the Aleutians, catching some 20 million salmon, including about 70 per cent of all red salmon taken in the North Pacific that season. The non-materialization of the predicted run is circumstantial evidence that Japanese fishing affected the Bristol Bay run in that particular year. On the assumption that the situation is due entirely to Japanese fishing of Alaska-spawned salmon in water assigned to them under the I.N.P.F.C., both industry and labour have tried by various means to force Japan to agree on a westerly move of the present abstention line. Proposed legislation would also ban imports of Japanese salmon. For the last two years imported Japanese canned salmon had exceeded the total production from Bristol Bay. Further proposals would ban *all* fish imports from Japan. Such proposals have been justified as "conservation measures." [10]

The recent appearance of deep-sea Soviet fishing trawlers in the convention waters has further complicated the issue. Subject to no treaty agreements the Russians feel free to fish salmon outside the territorial limits of Alaska. However, a trawler does not normally fish for salmon, and there is no proof that Russian vessels in the eastern Bering Sea are, or will be fishing salmon. Japanese trawlers have been trawling for bottom fish for several years in the areas where the Russian trawlers have been currently located.

International Law Standing

There are divergent opinions as to exactly what the United States'

[10] *Seattle Times*, 3 *April*, 1959.

case is based upon. The views of the fishery interests on this point can hardly be accepted despite the wide support they have been given. The State Department is, after all, the spokesman for the United States in international law. The United States' case is based upon the philosophy and practice of a sound conservation policy, especially in this case where there is a real danger of extinction of the resource. These conservation procedures have been approved and recognised by most nations in both the Rome Conference on Conservation in 1955, and the Law of the Sea Conference at Geneva in 1958. There is also the special interest of the coastal state in a fishery conservation programme. The peculiar nature of the salmon gives the United States presumed grounds for the opportunity of claiming a property right over salmon which are spawned, hatched, have their early development, and return to die in national and territorial waters. Added to these two factors of "special interest" and "property" claims, the United States has also claimed a historic right for exclusive exploitation of this resource. The fishermen of the United States and Canada are held to be solely responsible for the maximum development of fisheries, and have enjoyed almost exclusive rights in them.

The first official statement of policy by the United States came in November 1937, from the then Secretary of State Cordell Hull, after the Japanese high-seas fishing fleet had spent a season researching and catching some salmon commercially in Bristol Bay. In a note to the Japanese Government he argued that both the United States Government and private interests had developed the salmon resource to its present state. A law of Congress protected the salmon and put strict control on fishing activity. All this the Japanese had ignored. In the light of the annual investment of the United States in conservation, the hardship of the industry and steady decrease in total pack, the United States claimed a superior interest in Alaskan salmon, and suggested that it was to be regarded as an American resource. Such doctrines as "prior occupation", "prescription" and "usage" were used to bolster the United States' case. As a matter of policy the United States could not abandon its control in this case without some domestic hostility and public disgrace. The pre-war question was one of conservation and competing national interests, for this affair came at a time when there was growing friction between the United States and Japan on policy in the Pacific area.

Since the War, the United States' case has little changed. In 1943, Tomasevich thought that, in terms of power of protection, fishery conservation should have the same standing as revenue laws or defence of a neutral coastal state against belligerent activities.[11] Even Japan voted for the "coastal state" measures at Geneva in the hope that

[11] Tomasevich (1943): 35.

the extension of exclusive fishing rights would not be pressed by other countries. On the presumption that the production of most fisheries can be maintained at a near-maximum with conservation policies, the United States argues that, with increased activity in fishing, the most important aspect of the international law of fisheries is the promotion of effective conservation. The doctrine of the freedom of the seas has never been absolute, and extra-territorial rights for various functions have always existed. Allen has stated: "There is a definite distinction between the right of sovereignty and the right to exercise protective or preventive jurisdiction over an area outside the national domain." [12]

There seems to be some conflict within the terms of the 1956 International Law Commission articles. [13] The regulations do not "limit or restrict the freedom of the seas" and yet they include provisions for compulsory abitration of disputes over fisheries conservation. This would seem to rule against the absolutist doctrine of the freedom of the seas as a premise, as it would deny the necessity of achieving a balance of competing claims. There was however, an accepted qualification to the freedom of the seas by which abstention would be practised under sound conservation measures.

On the grounds that any salmon caught before they begin to run from salt water to fresh water are immature, the Washington State Director of Fisheries, Milo Moore, claims that salmon "should rightfully remain unmolested on the high seas." [14] It is further held that the scale and manner of the Japanese operation "violates the law of nature," and that if such an operation continues, salmon fishing in the North Pacific will no longer be an economic undertaking in four to ten years' time.

It is not so much the problem of moving or not moving the abstention line that is the question. It is rather the validity of the philosophy supporting the line that is debatable. The United States has used many arguments to strengthen its position. Perhaps the one that has won most international recognition has been that of the "special interest" of the coastal state in fishery conservation policy. The two concepts of abstention, and special interest of the coastal state, are, however, not strictly connected. Even if the arguments for the validity of the "American property" claim are accepted, the demands for the 15 degree shift westwards of the abstention line are founded on assertions that have limited support from scientific data. The crux of the matter lies in the interpretation of the protocol of the convention.

In 1940, Gregory observed that "allowing extra-territorial exploitation of the North Pacific reserves was distasteful not only to capital

[12] Allen (1956): 22.
[13] *American Journal of International Law* (1957): Supplement, 223 et seq.
[14] McLeod (1958): 134.

and labour interests but to the whole country." [15] Behind this is the concept that the Alaska-spawned salmon are distinctly a domestic resource, a concept which forms the basis of the American fishery interests' view in the dispute.

The second part of the Truman Proclamation of 1945 declared an extension of United States' interests over the contiguous coastal seas for the purpose of, among other things, effecting fishery conservation policy, on an agreement basis with other countries if necessary. On the presupposition that salmon do not migrate westwards outside the continental shelf, they could, for all practical purposes, be called an American resource. However, research shows that the salmon migrate far beyond the limits of the immediate coastal zone.

After the Japanese "scare" in the 1930s, effective assertion of exclusive United States and Canadian rights and effective instruments to carry them out were called for as an assurance to the fishing and conservation interests. The I.N.P.F.C. was to have been the effective instrument. It was to ensure the reciprocity or the equitability between Asian and American interests determined by origin of the resource as well as to stop "the invasion of the other fellow's *natural* fishing grounds." [16]

Two main lines of policy are being pursued at the moment, one direct and the other indirect. Within the terms of the I.N.P.F.C. the Japanese are being asked to suspend fishing in the area of intermingling where North American salmon occur in significant proportions. Indirectly the vested interests are attempting to force legislation through Congress that would bring pressure to bear on Japanese fishing activities through economic sanctions, such as banning imports from Japan of canned fish. There are also attempts to use organized labour to take action such as refusing to unload goods from Japan at the port of entry into the United States.

The United States Government agencies can adopt various policies. The F.W.S. is legally bound to reduce fishing activity by United States citizens in accordance with its commitment to its conservation policy. The United States Department of State can only present such facts as depletion and economic hardship to the Japanese, for the Japanese Government has exclusive power over her vessels on the high seas. At first glance it is difficult to see what the exact United States policy is, because there is considerable internal conflict between interested parties. The government policy is clear, but that of other interested parties is not. The salmon-fishing industry has stated that it "will not make any more sacrifices for the benefit of the Japanese." [17] It believes

[15] Gregory (1940): 412.
[16] Allen (1935): 560.
[17] *Pacific Fisherman* (1959): 7.

that the F.W.S. must provide not only minimum escapement, but also benefits to United States fishermen.

In 1938 Bingham wrote, "The future peace and security of the United States is our policy. It is the protection of our interests in our coastal fisheries off the Pacific coast damaging invasion and foreign use." [18] In 21 years this point of view has not changed.

THE RELATIVE STANDING OF THE TWO CASES

The reports of the various sub-committees to the Committee on Biology and Research on the Progress of Research on the Problems raised by the Protocol of the I.N.P.F.C. contain the best statement on current expert opinion of all parties to the convention. The Committee's report to the 1958 Meeting of the I.N.P.F.C. in Tokyo provides the latest statement. [19]

The proposed fields of study agreed upon at the first meeting of the I.N.P.F.C. in 1954 were: (1) the distribution of salmon on the high seas; (2) the use of various techniques to distinguish origin; (3) the tagging of salmon to obtain direct evidence of movement; and (4) oceanographic background study for this salmon distribution and movement data. At the 1957 meeting, the zone of intermingling was delimited as spreading over about 30 degrees of longitude between 170 degrees East and 160 degrees West. In this large area there is considerable difficulty in observing the distribution of salmon by their origin. The evidence shows that each stock may vary from year to year in distribution and size. The present research programme leaves many gaps, and it is impossible to describe the high seas distribution of all the important races quantitatively and qualitatively. Although the distribution of salmon in 1956 and 1957 prove the year to year variation, they do not contradict some over-all general conclusions which can be made.

Tagged red salmon of American origin have been found to predominate over Asian-spawned salmon as far as 175 degrees East and to exist as far as 170 degrees East; yet, Asian parasite characteristics have been found as far east as 170 degrees West. Within the intermingling zone there is a definite north-south apportionment, with American-spawned salmon predominating in the Bering Sea, and Asian south of the Aleutians. However, "the dynamic rather than the static nature of the distribution of red salmon is emphasized." So far any quantitative conclusions on pink salmon are impossible. Marked intra- and inter-seasonal fluctuations exist in number and distribution. No research work on chum salmon had been carried out prior to 1954. After three years of intensive research by tagging and scale ana-

[18] Bingham (1938).
[19] I.N.P.F.C. (1959).

lysis, a conclusion that the centre of the intermingling zone falls about 175 degrees West, with a 15 degree spread on either side, can be made. However, measurement of intermingling within the zone in terms of assessed proportions is still quite vague.

Riesenfeld wrote that "in the Law of the Sea national egotism, rash generalisations, insufficient consideration of basic questions have caused more conflicts and uncertainties than in any other aspect of International Law. [20] The present conflict over salmon exploitation in the North Pacific is well illustrated by this statement. Both sides have pursued increasingly incompatible policies. The motives behind these policies have often been influenced by chauvinism and local self-interest, and by political considerations not directly related to the problem in question, rather than by notions of equity.

At the extreme, the fishery interests interpret the United States' case as founded on the premise that she has property rights over the salmon, and relate this to a policy of exclusive exploitation based on origin. Japan, of course, does not recognize this in practice. Hence many arguments are not founded on common ground. By municipal law involving conservation measures, and by such policy as the terms of the I.N.P.F.C., the United States has passed legislation in an attempt to achieve her goal of exclusive rights to exploitation. However, municipal legislation has been flexible, whereas the terms of the I.N.P.F.C. have not. The United States has thus tried to find scientific evidence to substantiate its legislative measures.

More logically, legislation and exploitation should be in the light of scientific evidence because the mass-exploitation has a scientific base. In all fairness, however, it must be pointed out that the present illogicality of the line 175 degrees West, although due to the lack of proper scientific evidence at the time, cannot really be blamed on its creators as it was supposed to be a temporary measure to meet immediate demands. Rash generalizations on both sides have led to serious misconceptions. The Japanese claim that there is no conclusive scientific evidence which related the drop in runs of Bristol Bay salmon to Japanese fishing of salmon on the high seas (Fig. 2) and that, moreover, there is no evidence that the Japanese are catching immature salmon or that the small mesh nets used by the Japanese kill or injure young salmon. The Japanese maintain that the need for the stringent conservation measures in Bristol Bay is a result of the coincidence of a cyclical low with an unusual limited escapement (Fig. 3) in the two main years, 1954 and 1955, in which the 1959 run was spawned. However, it has been found that about one per cent of the salmon running in Bristol Bay in 1958 had gill-net marks. Even so, the questions remain: how many injured salmon die before reaching

[20] Riesenfeld (1942): ix.

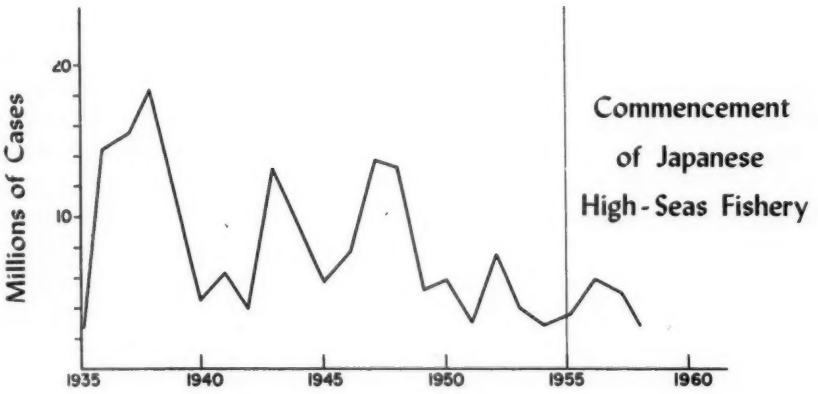

Fig. 2. Bristol Bay Red Salmon Packs.

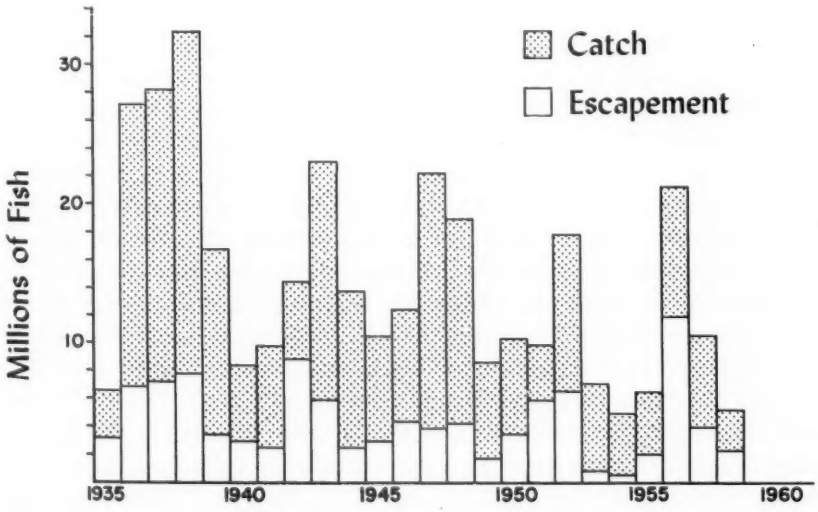

Fig. 3. Red Salmon Run in Bristol Bay.

Bristol Bay, and how many of the injured salmon that died, would die anyway due to other agents contributing to the "natural mortality" rate.

Professor M. Uda, of the Tokyo University of Fisheries, said in the spring of 1959: "It has been prematurely supposed by some that the main cause (of the decline of Alaska-spawned salmon) was over-fishing by the Japanese high-seas salmon fisheries. However, the declining trend began before Japanese high-seas fishing. The peaks in the sockeye pack in Bristol Bay were in the decade from 1930 to 1940. The fluctuation in natural environmental conditions such as the falling of water levels and freezing of spawning beds due to climatic change, together with deforestation, water pollution, dam obstructions, effect of natural enemies, predators, etc., and changes in survival, or mortality rates due to changes in ocean climate, may be mainly responsible for such a broad change in sub-Arctic waters." [21] Fisheries experts in the United States are in general agreement with Professor Uda's statement. Dr William F. Thompson, one-time Director of the University of Washington's Fisheries Research Institute, has stated, " . . . the (United States fishing) industry must not make the mistake of trying to remedy by law something that is a natural occurrence." [22] Obviously a distinction must be made between two trends. There is a definite over-all reduction in salmon runs for which the Japanese cannot be held responsible. However, a yearly fluctuation can also be observed.

The Japanese operate their high-seas salmon fishing industry in a manner similar to the way in which they operate several other industries producing goods deemed essential by the Japanese Government to the country's economy. It is an administered non-competitive industry entered within the hands of several large corporations. The industry, beset by political complications in the international field in which the government participates, receives government support. It is at the same time efficient and inefficient from the economic standpoint. In terms of scale of operation and utilization of available techniques, the Japanese industry is more efficient than the Bristol Bay salmon fishery. However, it is hardly efficient when certain considerations are examined. Such considerations would include its short-term policy of a high rate of discount to the future, the increased input necessitated by substituting transport and search costs for the natural concentration found at river mouths, and the failure to allow the salmon to reach full maturity, and hence highest quality which they attain as they begin to run upstream from the open sea. Return per unit effort, if measured by number of salmon per unit of gear fished, is far lower on the high seas where salmon are scattered, than in

[21] Uda (1959): 8-9.
[22] *University of Washington Daily*, 8 April, 1954.

Bristol Bay where they are schooled. On the high seas twenty-five men and a large boat must fish six to eight miles of net to equal the daily catch of two men in an open skiff using 150 fathoms of net. These questions of technical efficiency and high returns must be considered in the light of short-term exploitation and sacrifice of quality.

The United States' industry, on the other hand, has not been able to use optimum methods of exploitation because conservation legislation has been against this. Fishing techniques have become anachronistic. In 1939, when restrictions were not as severe as now, Deloach stated that " . . . such restrictions . . . serve to reduce the available supply for market purposes as well as to forestall wasteful use of the resource." [23] Up to the early 1950s, regulations were still severe in terms of legislation against more efficient techniques. The tendency has been for the F.W.S. to maintain a technical *status quo* in this manner. There have been various pressures behind such a policy. Ostensibly the desire for the conservation of the resource is fundamental. However, there are other factors, such as the vested interests of the boat owners, and the aspect of the asserted social benefit to the Alaskan native. Some type of benefit/cost analysis would be needed to gauge the validity of the last mentioned factor. There has been heavy investment in the industry to offset the lack of economies brought about by these inefficiencies. However, for the last 20 years, runs of salmon have been diminishing, hence productivity has further dropped. The great feature of salmon fishing is the lack of reliable prediction in terms of quantity, quality and time of species. Obviously, despite the factor of concentration, for the immobile site of the Alaskan industry this unpredictability is going to have a greater effect than for the mobile high-seas operation of the Japanese. This uncertainty means great risk. Up to the early 1920s the small cannery, typical of a risk industry, accounted for the major part of the pack. However, the tendency since then has been towards economies of scale by vertical integration, as the smaller canneries began to suffer competition from under-pricing by the bigger companies. As long as the runs did not deteriorate appreciably this was sound economics, and productivity increased. However, with progressive decreases in runs the catch dropped quickly below threshold requirements. The unit cost of the salmon has thus increased, giving the more cheaply produced Japanese article a comparative advantage and a strong competitive position in the American market. In fact, despite the low productivity per worker (or per capita unit in gear), caused by the need for search and large area covered by nets, the Japanese can put a lower cost per unit commodity on the American market due to other relative costs of factor inputs in the production process. Primarily lower wages per

[23] DeLoach (1939): 39.

worker in the Japanese industry enable it to achieve comparable labour costs to the American industry even though the Japanese use more men per salmon catch per unit of time. Secondly the Japanese government subsidises the industry in technical improvement as compared to government restraint in the United States' policy. These two factors would seem to explain the superior competitive position of the Japanese despite the natural advantage of concentration the Alaskan industry enjoys. Logically, then it would seem that if the United States' policy toward Bristol Bay salmon fishing were changed to one of government subsidies for technical improvement plus restricted entry into the market, the present industry would lower costs of salmon catch, and consequently lower prices of the commodity. This restriction would essentially mean the adoption of a monopoly operation of the industry after the Japanese style. The United States monopoly would never get out of hand as long as Japanese salmon were not restricted from the American market. There is one other important factor which must be considered. Because of the present nature of the resource, its availability rather than the volume of the market might ultimately set the limit.

The pressure for a solution to this international problem is essentially desired from the use or value both parties see in the resource. Therefore a solution to the economics of the salmon business in each country is fundamental in perpetuating the resource.

At the Law of the Sea Conference in Geneva 1958, the United States' case probably gained a little on the Japanese policy in terms of world opinion. The abstention principle found support, conservation was declared the duty of all nations, and the special interests of the coastal state were recognised. The convention must be ratified, and this will be binding only on the states accepting the obligations. Hence, regional and special organisations must continue to tackle conservation problems.

There is need for a permanent solution to the problem, a solution which must come through diplomacy and international law. However, there are many problems to be overcome before arriving at any agreement. Under the terms of the I.N.P.F.C., if any disagreements should arise in connection with the conclusions of research work, an independent committee is to decide on the recommendations to be made. [24] As Japan has never recognised the United States property claim, there is a question of the "spirit and intent' of the two disputants. Not only are there differences over the interpretation of the protocol of the I.N.P.F.C. but there are also varying opinions regarding the statistical inference of the data collected in salmon research. The accumulated scientific evidence since 1954 shows that disagreements will increase

[24] United Nations (1955): 47.

as the data mount. Complications and intricacies, unimagined in 1952, are becoming more evident as the sum of Canadian, American and Japanese data is brought out annually at the I.N.P.F.C. meetings. At the same time, any independent committee would be faced with so many alternatives that an objective solution based solely on scientific data will probably be impossible. Diplomatic compromise would then probably be necessary to settle the issue. Unilateral action can be ruled out as a solution, for it can scarcely be the basis of a fundamental and equitable solution of the fisheries problem. The United States realises that any policy of extending territorial jurisdiction can be a two-edged sword. Salmon fisheries are not the only important fisheries of the United States. The tuna-fishing industry of California finds the United States in the role of the high-seas state, and there is regional pressure from California against any national policy which would adversely affect the vested interests of the Californian high-seas tuna fleet.

The Canadians act as independent observers at the I.N.P.F.C. meetings. As they are satisfied that no salmon spawned in Canadian streams cross the 175 degree West line at any time, the Canadians can afford to be neutral. The Canadians state that it is not just a case of picking up the abstention line and moving it a little westwards, as the United States demands. They suggest that several new lines must be drawn to divide the stocks of salmon by species determined by an equal-ration proportion in terms of numbers of each species. These lines would have to vary from season to season. If such a solution were to be founded on scientific evidence in the terms that the I.N.P.F.C. demands, then it could only take place when and if sound and conclusive means of predicting salmon movement are developed. So far there is a lack of sufficient evidence for conclusive statements of any fundamental nature. Interpretation of data presently available varies, and allows for no conclusive proof of determinant factors. A mutually satisfactory line based on averages of migration extents seems a long way.

Japanese and American policies are at opposite poles. Even with some flexibility of either policy, there seems little possibility of a solution coming through the efforts of the contending national and sectional parties. There is a legal deadlock at the international level and disagreement on the interpretation of scientific data. However, diplomacy may yet find a way.

From this study of the conflict over the utilisation of the natural resource several features come to light: (1) the limitations and possible dangers of an exclusive fishery pact covering large areas of the high seas; (2) the economic need of Japan to maintain this valuable export at its present level; (3) the basic difference between the economics of the Japanese and American salmon fishing organisations; (4) the basic contrasts in attitudes between Japan on one side, and the two

principal "coastal" states, the United States and the Soviet Union, on the other, over the depletion and exploitation of salmon stocks; and (5) the confused state of international law relating to the freedom of the high seas and fishing rights.

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The Pakistan Cotton Industry

J. W. MACNAB

A characteristic of newly emergent nations is the desire to achieve industrial independence. Such nations usually have surplus labour which industry can absorb and many produce raw materials which in the past have been manufactured elsewhere. Initially, outside of the Communist block, industrial efforts are concentrated on the output of consumer goods. It is not until industrialisation has proceeded some distance that more emphasis becomes placed on the production of capital goods. [1]

This typical pattern has been followed in Pakistan. At Partition, in 1947, Pakistan was a producer of agricultural and animal products which formed the basis for a large part of the major industries of the Indian sub-continent. Few factories were located within the new boundaries of Pakistan and there was thus an urgent need to create within the new state industries to utilise the indigenous raw materials. Consumer goods industries, particularly food and textile manufacturing, were most popular with private investors as the technical knowledge necessary for their establishment was provided by refugees who had migrated from similar industries in India. Manufacturing of consumer goods thus became dominant immediately after Partition and its lead continues.

The efforts of the State have been directed to establishing those basic industries neglected by the private sector, in particular industries producing capital goods. To this end, the Pakistan Industrial Development Corporation was created in 1952. The industries it developed included jute, paper and board mills, fertiliser factories, and heavy engineering, ship-building, heavy chemicals, and iron and steel plants. Once under way, many of the plants were transferred to private ownership, but the State retained certain essential industries such as hydro-electric plants. State enterprise has taken precedence over private enterprise especially in the use of the limited foreign exchange so that development in the private sector has sometimes been hampered. Nevertheless, the recognition of the separate and interdependent roles of state and private enterprise and their successful marriage has been one of Pakistan's greatest achievements.

[1] United Nations (1958): 10.

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This paper is, of necessity, restricted to the study of one industry, the cotton industry. This industry, the most successful undertaking in the private sector, has been chosen for an analysis of its development problems illustrates the difficulties facing Pakistan in the post-Partition decade.

At Partition, out of a variety of promising industrial enterprises open to private investors, the cotton industry was their first choice. This is not unusual. In both Britain and Japan it was one of the first factory industries initiated because of the simple technological processes involved. Other factors contributed to the popularity of the cotton industry. Technicians who had fled from the Indian mills were available. Pakistan produced 40 per cent of the raw cotton crop of undivided India yet had less than five per cent of the cotton textile mills.[2] The cotton industry too, has low capital demands, the pulp and paper industries in contrast, requiring more than five times as much capital per employee.[3] Clothing is the second basic need of a people and for Pakistan's climate, cotton clothing is most suitable, consequently there was an assured market. Development in this industry was therefore rapid and spectacular.

GROWING THE CROP

The 'Cotton Belt' in West Pakistan is a well-defined strip bordering the Indus and its tributaries (Fig. 1) an area in which cotton has been grown for at least 4,000 years. As cotton is an irrigated crop, its greatest acreage is in the irrigated areas of the former Sind and Punjab provinces and in the former Bhawalpur and Khaipur States. With the completion of irrigation schemes in the doab between the Indus and the Jehlum it can be expected that the cotton belt will extend westward into these newly irrigated tracts. In 1957-8 cotton was grown as a summer crop on 3.59 million acres only being exceeded by the chief winter crop wheat grown on 11.71 million acres.

The quality of raw cotton depends on the length, strength and colour of the staple and the indigenous (desi) varieties with short staples of $\frac{3}{8}$ to $\frac{5}{8}$ inch are only suitable for spinning into coarse yarn or for mixing with wool. No deliberate improvement of the cotton plant had been undertaken in Pakistan until the introduction of American seed in 1914. American type cottons, with their longer staples of $\frac{7}{8}$ to $1\frac{1}{8}$ inch, can be spun into finer yarn and are consequently in greater demand both at home and overseas. Efficient seed multiplication and distribution schemes have been in operation for over 30 years[4] so that in 1959, 86 per cent of the area under cotton was planted to American

[2] Vakil (1950): 35.
[3] United Nations (1958): 10.
[4] Pakistan Government (1952A): 24.

Fig. 1. West Pakistan Cotton 1958-9

Acreage. Total 3,253,774 acres. American varieties 2,796,793; Desi varieties 456,981 acres.

Production. Production in bales of 392 lbs. each. Total 1,529,203. American varieties 1,370,011; Desi varieties 159,192.

varieties which yielded 90 per cent [5] of the total production. Yields from the two types of cotton were significantly different. American type cotton averaged 192 pounds of lint per acre and desi varieties 136 pounds of lint per acre. These yields are low by world standards. Egypt, a high producer, has average yields of 470 pounds per acre. [6]

[5] Personal Communication, Pakistan Ministry of Agriculture (1960).
[6] Commonwealth Economic Committee (1959): 56.

Cultivation practices are generally primitive. One authority recommended [7] that a new variety of cotton be sown in rows two and a half feet apart (broadcast sowing is still common) and that nitrogenous fertilizer be applied at the rate of 50 pounds per acre. Despite acknowledgement that fertilizer greatly increases yields, in the early 1950s less than one pound of fertilizer was used per acre. Japan in contrast, was using 60 pounds per acre. The completion of a fertilizer factory at Daudkhel with its annual capacity of 50,000 tons will help to rectify the position, but if the whole output was applied to cotton fields it would still only provide 30 pounds per acre. Another factory, to produce 160,000 tons of fertilizer per annum, is under construction at Multan but more production is still required.

PROCESSING THE CROP

Ginning

From the farms the cotton is packed into loose bales each weighing 200 pounds, and transported by camel, bullock cart, or lorry to the ginning factory which is usually located alongside transport routes within the growing area. Much depends on the efficiency of the ginning; the quality and value of the lint is reduced by carelessness and by poor equipment. In an efficient factory, which was inspected by the writer at Mirpur Khas in Sind, the raw cotton was spread on to concrete sorting floors where women tediously picked out the more obvious dirt, twigs and unripened bolls before it was carried into the factory to be given its first mechanical cleaning. Such meticulous attention is rare. Dirt is often not removed and becomes pressed into the lint. Precleaning equipment is either non-existent or in bad order. Intentional adulteration is also practised, desi cotton is mixed with American varieties and endeavours made to sell the whole as high quality cotton.

It is recognised that efficiency in the ginning industry has decreased since Independence. [8] Most ginning factories were the property of Hindus who had fled the country. This evacuee property was, until recently, rented on a short-term basis. There was thus no incentive to maintain or improve the equipment, and deterioration was rapid. The total number of roller gins in 1959 was 11,695 and of saw gins 482 which according to some estimates is in excess of requirements. Roller gins are more popular than saw gins in Pakistan but this is not so overseas. In the United States 90 per cent of the crop is processed by saw gins which produce a cleaner, longer and stronger thread. But the saw gin is more complicated than the roller gin and if

[7] Khan (1959): 39.
[8] Afzal (1959): 11.

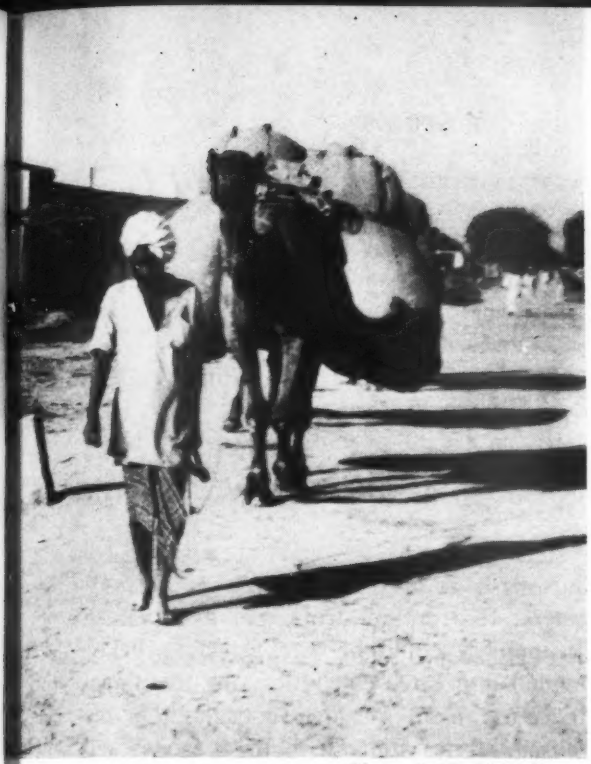

Fig. 2. Camel carrying 200 lb. bales of raw cotton to the ginning factory.

Fig. 3. Weighing, grading and recording the raw cotton in the yard of the ginning factory at Mirpurkhas, in Sind.

Photo: J. W. Macnab

Photo: J. W. Macnab

badly set, as is often the case in Pakistan, is capable of doing immense damage to the fibres. Today lack of technicians, rather than wilful neglect, appears to be the greatest obstacle to efficiency in the industry. Existing units are however being modernised and new units are being established in areas where cotton growing is expanding, particularly in the Thal and in Lower Sind.

From the ginning factory the raw cotton is conveyed to the Pakistani mills or to Karachi for export. Mills may process the cotton up to the finished cloth or produce yarn for use in weaving mills or on handlooms.

The Handloom Industry

The ancient handloom industry played its greatest part in the economy of the industry during the transitional period of the post-Partition years when consumers were cut off from manufacturers in India and before large-scale industry could be established in Pakistan. This industry can be divided into three categories: the traditional village handlooms producing coarse cloth for local consumption; the handlooms producing specialised fabrics for sale both at home and overseas; and the handlooms operated in small factories [9]

Since Partition, handlooms grouped in factories have become dominant and weaving has become an urban rather than a rural occupation. In Karachi it was not uncommon in the 1950s to see a small factory established on the footpath of a main thoroughfare, with refugees living in squalor beside the looms. This atypical development in urban areas took place when large numbers of weavers migrated from India at Partition. Their re-settlement was unorganised and they established themselves wherever they could. Cities and towns offered them facilities for credit, raw materials, and markets, facilities which were not available in the villages. A small class of entrepreneurs grew up and although some of the factories were well managed, most were badly organised and badly constructed. There was the social blot of exploited labour; workers were paid low wages, they had no security of employment and working conditions were usually deplorable. Cotton textiles were manufactured on 85 per cent of the handlooms with an average daily output of nine yards of cloth per loom. Initially, supplies of suitable cotton yarn were short and the Government permitted unrestricted imports. Though this gave some assistance the removal at the same time of restrictions on the importation of cotton cloth opened the way for unwelcome competition from cheap Japanese machine-made cloth. The Korean War provided a temporary stimulus and the greatest expansion in the industry took place at that time. It is claimed that handlooms then supplied 40 per cent of the country's requirements of cloth.

[9] Second Five Year Plan (1960): 237.

Photo: J. W. Macnab

Fig. 4. A handloom 'factory' established by refugees on the pavement of a main street in Karachi.

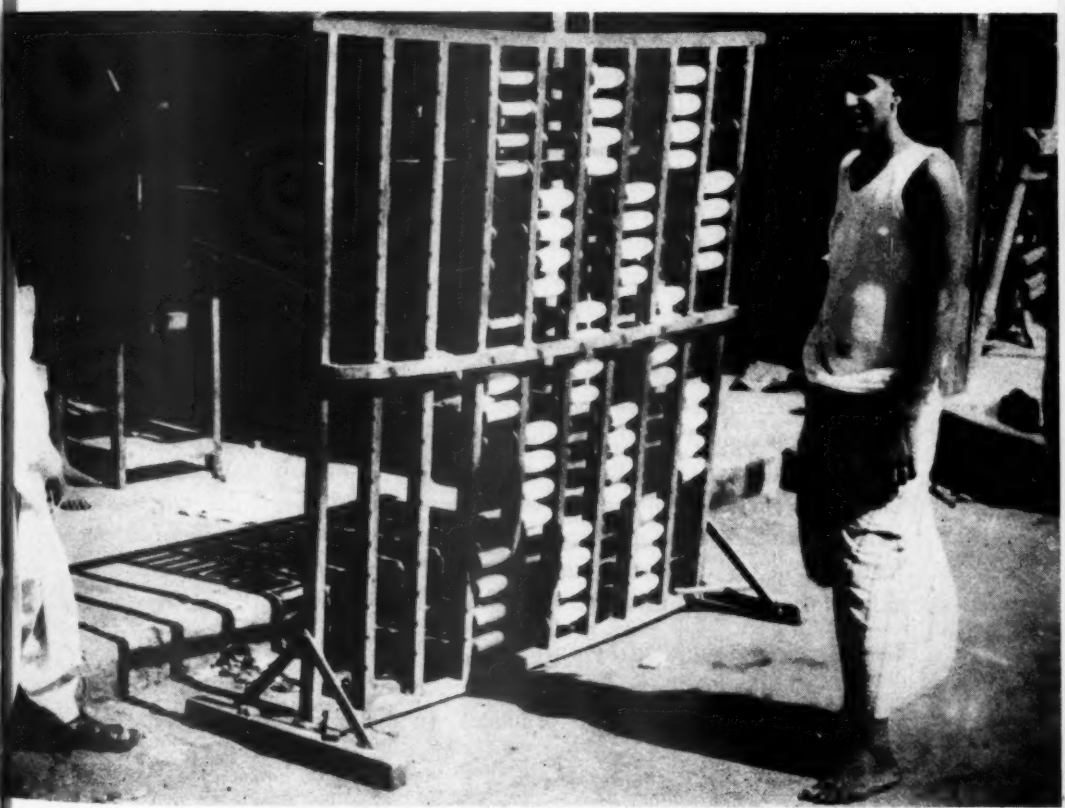

Photo: J. W. Macnab

Fig. 5. Threading up a handloom in a poorly illuminated pavement 'factory'.

Since 1953 the importance of the handloom industry has declined, in part due to poor standardisation of quality and in part due to the increasing competition from the indigenous large-scale industry. Independent weavers were gradually forced by economic necessity to become contract workers or wage earners in the handloom factories. Because of their urban location few had subsidiary employment and the average wage of Rs. 40 per month provided only a bare existence. The Fact Finding Committee on Handlooms considered that neither the Provincial nor Central Governments had given the industry as much protection, assistance and guidance as it deserved considering the numbers dependent upon it. The Committee reported that in Bahawalpur out of 3,000 looms operating in 1953 only 700 were working in March 1955. In all West Pakistan in 1955 out of the 234,418 looms remaining 36.8 per cent were idle. [10] Yet it was estimated that about a million people were directly supported by the industry and almost another half million were in subsidiary industries.

This small industry was seriously handicapped by production methods that were outmoded and inefficient. Finance was lacking, there were difficulties in obtaining suitable yarn at cheap prices, there were poor marketing facilities and there was the ever-increasing competition from large-scale factories. Investment per worker was low but investment per unit of production was so high as to make handlooms non-competitive with power-operated looms.

The main remedy for the handloom industry seemed to be re-organisation into co-operatives similar to those operated in Japan. [11] These co-operatives jointly owned and managed by the weavers would be responsible for purchasing supplies, carrying out certain phases of production such as finishing, and would market the finished cloth. The Small Industries Corporation was established by the State in 1956 to provide similar assistance. In addition the Corporation could undertake research, encourage mechanisation and grant financial aid. However it was noted in the Second Five year Plan that the ambitious support programme of the First Five Year Plan had not been implemented. [12] The second Plan recommended that only the traditional village industry be supported, but it found little economic or social justification for continuing the outmoded handloom factories and considered that these should give way to power looms. [13]

Large-scale Manufacturing

Initial difficulties in the establishment of a local textile industry were imposed by traditional practices. In the past Moslems had been

[10] Pakistan Government (1956A): 17.
[11] First Five Year Plan (1956): 310.
[12] Second Five Year Plan (1960): 221.
[13] Second Five Year Plan (1960): 237.

traders not industrialists and they preferred family partnerships to joint stock companies. However, these difficulties were overcome. Great inducements to private investors were offered by the Government; industrial estates were created where sites and services were made available, and the State encouraged or created basic industries such as cement factories to provide the raw materials for buildings. Taxation concessions were generous and those who entered the cotton industry reaped large rewards. It was the rare organisation that did not recoup its capital in less than five years.

The distribution and type of cotton mills are shown in Table 1.

TABLE 1

Type and Distribution of Cotton Mills
(Position at 30th June, 1959)

Areas	Mills Installed				Spindles Installed	Looms Installed
	Composite	Purely Spinning	Purely Weaving	Total		
Karachi:						
Karachi	23	7	—	30	604,852	9,816
West Pakistan:						
Lyallpur	7	1	1	9	293,332	5,565
Multan	1	4	—	5	158,504	1,520
Hyderabad	6	4	—	10	116,080	1,249
Rawalpindi	2	1	—	3	66,280	919
Thal	2	—	—	2	51,344	817
Peshawar	3	—	—	3	50,100	852
Khairpur	3	—	—	3	44,620	780
Rahimyar Khan	1	—	—	1	36,440	501
Lahore	3	—	1	4	36,232	607
Okara	1	—	—	1	36,212	1,290
Jehlum	1	—	—	1	25,184	720
Sargodha	1	—	—	1	34,984	500
Khanpur	1	—	—	1	15,200	300
Quetta	1	—	—	1	12,400	250
Haripur	—	1	—	1	10,000	—
East Pakistan:						
Dacca	7	5	—	12	246,606	2,525
Chittagong	2	2	—	4	67,412	246
Kushtia	1	—	—	1	19,288	537
Bogra	1	—	—	1	12,400	—
Khulna	—	—	1	1	—	110
TOTAL	67	25	3	95	1,927,470	29,104

Source: Pakistan Government (1959)

Factories, equipped with machinery from Japan, the United Kingdom and West Germany, have tended to be concentrated near a few large towns. Karachi became the leading centre because of the advantages of the port, the special facilities of the industrial estates, the close proximity of the centre of administration and the presence of a large business class who settled there on migration from India. On purely economic grounds, new capacity should be installed where costs of production and transport are low but political and parochial demands have led to the establishment of factories as far away as East Pakistan even though these mills have to rely on cotton grown in the West.

The 17 mills with 177,148 spindles and 4,824 looms of 1947 have increased to the 95 mills (19 in East Pakistan) with 1,927,470 spindles and 29,104 looms of 1959 processing some 200,000 tons of cotton annually. Characteristic of the cotton industry in Pakistan are the composite mills which spin, weave and finish the cotton in the one factory. In 1947 all were composite and in 1959 in West Pakistan 56 were composite, 18 were spinning and two were weaving mills. This is in contrast to the English pattern where separate factories spin, weave and finish the cotton.

Some 200,000 workers are directly employed in the cotton mills together with 300,000 in subsidiary and auxiliary industries.[14] At first local operators were trained by the foreigners responsible for installing the machinery. Today training, not only of the operators but also of the managers, is often rudimentary. The need for technical education is recognised by both State and industry and great efforts are being made to overcome both the quantitative and the qualitative shortage but education facilities at all levels are inadequate. Finance, buildings and teachers are in short supply. For example it is estimated that in the next five years 70,000 primary teachers and 14,780 secondary teachers will be required. However training for skilled factory personnel can often be provided on the job. With strong village and family loyalties, employment in a factory is often restricted to kinsfolk of those already employed. The potential employees are trained by their relations, often without the knowledge of and at no expense to the company, as such training can lead to a permanent position and to a measure of security.

Industrial development in Pakistan entailed a social as well as an economic revolution. The migration of workers from agriculture to industry has brought new urban concentrations and has given rise to large-scale problems of housing and sanitation. The social security provided by the extended family in an agricultural setting has been destroyed by the creation of nuclear family units in the cities. A large manpower reservoir prevents effective trade unions being established

[14] Personal Communication, The Cotton Board, Manchester (1960).

which could bargain for higher wages. There is as yet no fixed minimum wage and wages vary from plant to plant, but perhaps average Rs. 80 per month. Wages may be low by Western standards but not by local standards and wages are regular and there is some security. In the best factories medical, canteen and housing facilities may be provided with creche and educational facilities for the children. There are too, the beginnings of state social insurance in Pakistan with Workers' Compensation, employee's provident fund and maternity benefit schemes now provided for in Government legislation. Joint family security is giving way to State social security.

SIGNIFICANCE OF COTTON IN THE PAKISTAN ECONOMY

Manufacturing as a whole is still subsidiary to agriculture, but agriculture now depends heavily on indigenous industry for implements, fertilizers, power, transport and processing of agricultural products. Almost 40 per cent of the increase in national income during the First Five Year Plan period was contributed by industry. From 1950 to 1959 production in large-scale manufacturing industries increased five-fold. Textile industries accounted for almost half the industrial investment and employed more than one-third of all those engaged in large-scale industry.

The establishment of the textile industry has led to great savings of foreign exchange. Cotton cloth was the largest single import item in 1951-2 comprising some 18 per cent of all imports with cotton yarn accounting for a further 13 per cent, [15] at a total cost of some Rs. 625 million. The successful development of the cotton industry exceeded expectations and not only were home demands fulfilled with an annual production of 12 yards of cloth per capita but by 1956 there was a surplus available for export. In 1959-60 cotton piece goods were earning Rs. 52.2 million and cotton yarn Rs. 175.4 million [16] of overseas currency, approximately one-tenth of the foreign exchange earnings.

Exports of raw cotton are still important to Pakistan but as she produces only about five per cent of the world's cotton she can have little influence on world prices. In the past Pakistan has been adversely affected by the domestic policies of the larger producers. The United States in particular exerts a decisive influence on the world market especially on the medium staple type of cotton grown in Pakistan. [17] A domestic decision of that country to increase production can reduce the price that Pakistan receives for her raw cotton, and a stable price level cannot be guaranteed. With Pakistan now exporting textiles

[15] Pakistan Government (1952B): 13.
[16] Pakistan News Digest (Sept. 1960).
[17] Commonwealth Economic Commision (1958): 24.

as well as raw cotton there is a broadened basis of trade and this partially relieves her of dependence on a few economically important countries. The problem of finding new overseas markets is, of course, a major one.

A strong drive for overseas trade has been made but export potentials are limited. China, Taiwan, Hong Kong and South Korea have newly entered the export field and have to compete with the established traders of India, the United Kingdom and Japan. Even these countries are being affected by increasing competition and so serious is the glut in the market that advanced cotton textile exporting countries such as Japan, 'have increasingly switched over to the production of goods in strong demand, such as machine tools and electronic equipment.' [18] Without knowledge and experience Pakistan cannot at present compete in the field of fine fabrics, a market dominated by the United Kingdom and Japan, though recent aims have been to produce finer yarns for which there is a strong home demand. Total domestic demand is expected to rise to 14.5 yards per capita by 1965 and to maintain both domestic supplies and textile exports the Second Five Year Plan has as a target 2.5 million spindles, 200,000 of which are earmarked for the production of finer yarns.

Pakistan has some advantages: her machinery is new and modern, she is a producer of the raw material and consequently has no excise payments, and has low transport costs. There is still a demand for raw cotton on the export market and a higher standard of living at home would increase internal consumption.

Of basic importance to the development of the cotton industry has been Pakistan's three major needs: the need to process her limited raw materials to the greatest extent, the need to raise the standard of living of her people by providing full employment, and the need to save overseas exchange. The cotton industry was technically and politically easy to establish and consequently has dominated the post-Partition period. In its social aspects development has been painful but its importance reaches far deeper than the general raising of the national income. This was Pakistan's first venture into large-scale industry and the long term importance of its success and its implication for further economic development is greater than can ever be shown by production figures or financial statements.

[18] United Nations (1959): 73.

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The Asian and Pacific Scene

CHINA: THE DEMOGRAPHIC REVOLUTION

Throughout China's history flood and drought have caused untold suffering and, by drastically cutting back population, have maintained a precarious balance between man and food supply. Drought caused the greatest famines; the 1877-8 famine on the loess plateau resulted in between nine and thirteen million deaths, and was equalled by that of 1928 which caused three million deaths in Shensi alone. The 1931 Yangtse floods rendered twelve million homeless, those of 1935 affected fourteen million people. The classical checks to population growth have thus certainly operated at many points in China's history; their influence is reflected in past growth rates which between 1776 and 1850 averaged 0.63 per cent per annum, dropping to an average of 0.3 per cent between 1850 and 1953. (Ping-ti Ho, *Studies on the Population of China,* Cambridge, Mass., 1959, p. 277).

In the past, the impact of these natural calamities has always been greatly aggravated by wars, social disorders or the weakness of the central government. Today, by contrast, a strong central government, an efficient local administration and a boldly conceived policy of social and economic development are reducing and will eventually eliminate these 'catastrophic deterrents' to population growth. The social and political organisation of the last decade, and above all the development of the commune system, has made possible a vast programme of irrigation and river control and this programme is wiping out many of the old causes of poverty and insecurity. The events of 1959 and 1960, when the country was affected by unprecedented droughts and floods, showed that the Chinese are achieving a high degree of mastery over their environment and thus over their demographic future. The commune system provided at the same time the institutional framework for a nationwide attack on disease and poor hygiene; indeed, R. Hughes suggests 'that the greatest and most enduring achievements of the organised communes . . . will prove to have been recorded in these basic advances in public health and hygiene . . .' He goes on: 'In theory, this development of medical care in Chinese villages need not have waited on the development of the commune. But, in practice, the communes came first: it is as though the harsh regimentation of life was a necessary discipline for the prolongation and protection of life. (*The Chinese Communes,* London, 1960, p. 71. See also views of visiting Western doctors cited by Felix Greene, *What's Really Happening in China,* San Francisco, 1960, pp. 11-13.)

The political and social revolutions in China have thus paved the way for a demographic revolution whose scale and implications are only now becoming apparent. Birth rates for the country as a whole have dropped slightly (from 37 per thousand in 1952 to 34 in 1957) but death rates dropped sharply (from 18 per thousand to 11). The decline in infantile mortality rates has been particularly marked; in Shanghai, for example, the rate dropped from 81 per thousand to 31 in four years; expectation of life at birth is now claimed to be 54 years (cf. India, 35 years in 1951.) All these features suggest a continuing high rate of absolute increase even if family sizes should decline, for the size of the contingents entering the reproductive age groups will increase for some years. Recent trends in China's population are summarised in the table below:

Growth of China's Population (Mainland only)

Year	Population	Increase over preceding year	
		Numbers	Percentage
1953	587.9 m.	13.1 m.	2.3
1954	601.7 m	13.8 m.	2.3
1955	614.6 m.	12.9 m.	2.2
1956	627.8 m.	13.1 m.	2.2
1957	649.5 m.	21.7 m.	3.4
1958	673.0 m.	23.5 m.	3.6

Source: S. Chandrasekhar, **China's Population,** Hong Kong, 1959, p. 55.

The immediate economic problem posed by this population growth is that of providing food for a population of some 700 million, increasing at a rate of over 20 millions a year. He observes 'It seems possible for China even to increase food production at a rate higher than that of her population growth for a limited number of years if advanced agricultural technology is widely introduced. But the long range prospect is bound to be far different. In the first place, her present population is already very large and even a moderate sustained growth will be a great strain on her agriculture. Secondly, more labour-intensive cultivation and introduction of advanced agricultural technology cannot in the long run prevent agriculture from reaching the point of diminishing returns.' In China, however, the success achieved in expanding food production confirms many experts in their view that, with agricultural techniques in a process of rapid transformation, they are very far from even approaching the point at which diminishing returns set in. Certainly, the scope for increasing output on the existing (or even a reduced) crop area is very large, while, from a long term viewpoint, there remains the possibility of pushing the agricultural frontier deeper into the arid and micro-thermal regions of the West and Northeast and of reclaiming for arable or tree cropping the uplands of Central and South China which were devastated by robber-farming in the seventeenth and eighteenth centuries. At the present, then, it is difficult to envisage a major food shortage as a limiting factor to population growth in the foreseeable future.

The problem of absorbing into the country's economy the increasingly large contingents entering the working age groups is more critical. The annual increase is estimated at four million during the First Five Year Plan, five million during the Second Five Year Plan and seven million during the Third Five Year Plan. The cities can absorb approximately one million industrial workers annually; the residue must be absorbed in the rural areas. Some commentators see the development of the commune system, with its massive investment of labour in major irrigation and flood control projects and its drive for widely dispersed industrialisation, as an attempt to cope with this problem. As Leo A. Orleans writes 'Almost simultaneously with the abandonment of the birth control policy came the creation of the Communes and the inauguration of the now famous 'great leap forward.' Whether the timing here was planned or fortuitous is not known, but the effects are indisputable. By utilising millions of men in numerous construction projects ... an artificial labour shortage was created ...' ('Birth Control: Reversal or Postponement,' *The China Quarterly,* No. 3, July-Sept. 1960, p. 65.)

Only very rough estimates of these new labour needs in the rural areas are available. Su Chung writes 'To double China's present grain and cotton output ... at least 50 million more people will be needed ... the amount of work involved (in water conservancy construction) would normally keep 30 million people busy

for a year.' (*Peking Review*, July 1, 1958, p. 9.) Both figures will, however, be significantly affected by mechanisation which, as Mao Tse-tung has said, is 'the fundamental way out for agriculture,' and under these circumstances the absorptive capacity of the countryside will depend increasingly on the progress of rural industrialisation. Developments in the last two years underline the critical need for an increase in the productivity of labour and for the continued diffusion of technical education if industrialisation and diversification are to make their maximum contribution. It may thus be argued that China's ambitious programme of technical education will play a major role in easing, if not actually solving, her population problem. A. Sauvy has said that 'an overpopulated country is an under-educated country' ('Evolution récente des idées sur le surpeuplement' in *Population*, Paris, June-July 1960, p. 481) and has shown how an increase in technical competence, by making possible an increasing diversification of the economy, can significantly ease the pressure of population. In a country such as China, where until recently virtually the entire population was illiterate and completely ignorant of any technical skills, his concept has an even greater relevance.

It is argued by some that the high rate of population growth makes it difficult for China to accumulate funds and for a country desperately striving to emerge from poverty and to modernise this is a pressing need. A writer in the *Peoples Daily* (Peking) quoted by Chandrasekhar (p. 24) expressed the view 'If the speed of our population growth slows down, improvements in the livelihood of our people will quicken correspondingly.' Other Chinese writers have claimed that 'Facts show the opposite. In 1952, 18.2 per cent of China's national income went into accumulation; it rose to 22.5 per cent in 1956 . . . Accumulation by peasants and co-ops is also rising. In the First Five Year Plan, the sum increased by 47 per cent . . .' However, it seems clear that the provision of consumer goods and of social services must, in the case of a country with a rapidly expanding population, absorb investments which might otherwise have been diverted to strengthening the heavy industry sector of the economy; the result will be a retarded pace of economic development. Comparative studies of the problems of other underdeveloped economies reveals the magnitude of the effort involved in achieving a steady rise in living levels in the face of increasing population; thus, L. Tabah shows that 'a 2 per cent annual increase in *per capita* consumption, in a country where the annual *per capita* income is under 100 dollars, amounts to a doubling of individual consumption in 35 years and in the case of a country with a high birthrate investment needs exceed 30 per cent of the national income during the first 25 years' (quoted in P. George, *Questions de la Géographie de la Population*, Paris, 1959).

The birth control campaign—or, as the Chinese prefer to call it, 'education movement'—appears to have been inspired by these considerations. Public discussion of the need for population control began in 1954, when Deputy Shao Li-tzu raised the problems before the People's Congress. He stressed that 'his plea for birth control had nothing to do with decadent, outmoded and reactionary Malthusian doctrines. (It) was based on the need for protecting and improving the health of hard-working Chinese mothers and affording better opportunities for their children.' (S. Chandrasekhar, *Contemporary China*, ed. E. S. Kirby, Vol. III, Hong Kong, 1960, p. 23.) By mid-1955 the official support of these ideas was indicated by Premier Chou En-lai's plea for 'appropriate control in respect of births.' The peak of the campaign was reached in March 1957 when a Birth Control Research Committee was set up 'to co-ordinate experience and research in contraception.' 'Birth control . . . and planned childbirth' said the Minister of Health, 'are actually indispensable to morality and the State's responsibility to the people.' Population control was to be achieved by contraception (120 million

sheaths were sold in 1957), by clinical abortion, by late marriage or by the sterilization of either partner and the more enthusiastic newspapers suggested targets for the campaign—a lowering of the urban birth rate by 30 per cent and of the rural birth rate by 20 per cent. Mass education campaigns in the cities, and pamphlets, contraceptives, and medical advice in the rural areas, spread the new ideas throughout China.

In early 1958 there was an abrupt change in policy. There was strong criticism of those, such as Professor Ma Yin-ch'u, who regarded the population problem as a barrier to economic progress and socialisation, and an increasing emphasis on the labour shortage. By the end of 1958 the official line—that a large population was an asset—was firmly re-established. Han Suyin discusses the change in policy and suggests that it was a response to the psychological and practical needs of the situation; that 'it is not correct to speak of China as having reversed its policy . . . what can be said is that the government is suspending judgement.' ('Birth Control in China—Recent Aspects,' *The Eugenics Review*, Vol. 52, No. 1, 1960, p. 20.) The psychological need for a re-examination of the situation arose from the necessity of considering peasant reactions. Any policy of family limitation might well suggest to the peasant 'that the future was insecure, that a famine was impending, since the government asked them to have fewer children! That meant the government was frightened there would not be enough food to go round. Panic of this kind in China is enough to paralyze the countryside, to set off extraordinary reactions and to sap the foundations of the order which the Chinese government was trying to achieve.' The practical basis for a re-evaluation of the situation lies in the fact that capital accumulation in China still depends on the labour of men's hands since machinery is not available and, in the transition period during which a technologically competent and scientifically educated peasantry emerges, all the ambitious plans for the remodelling of the country's economy demand heavy investments of man-power. This interpretation, it will be seen, is rather different from the interpretation of Leo Orleans cited above. Han Suyin sums up 'There is, therefore, no incentive to limit the family as a *necessity*; but there remains the incentive to limit the family as a *convenience* . . . With a higher standard of living, and since a large family *is* an inconvenience, the majority of China's people may demand family planning as a convenience, but at present this is still a minority.' She comments 'There are no such things as inflexible policies in China, at any time' and certainly population policy has shown, and is likely to continue to show, major shifts as Chinese planners attempt to co-ordinate the results of China's demographic revolution with Marxist teachings and the exigencies of their development plans.

KEITH BUCHANAN

THE ASIAN CITY: PROBLEMS AND PROSPECTS

The assertion that economic development is necessarily associated with increasing urbanisation has been widely accepted by economists. In the face of the seeming inevitability of this process the present piecemeal policy adopted by many Asian countries to ameliorate the economic, social and physical problems associated with urbanisation would appear to be the only logical course. Such an approach would say that, after all, difficulties of rapid urbanisation can be only partially solved. The overcrowding in slum conditions can in part be prevented by the creation of new housing areas, such as a Petaling Jaya or a Kebayoran; the rural in-migrants' problems of adjustment in the city can be partially alleviated by education, or community schemes; the economic problems of unemployment can be partially tackled by the creation of new industries. Such policies attack the symptoms but not the cause.

The possibility that the actual process of urbanisation could be slowed down, or at least substantially modified, while economic growth still continues, has scarcely been entertained by planners. It is for this reason that the UNESCO publication on urbanization in Asia is important (P. M. Hauser (Ed.), "Urbanization in Asia and the Far East," *Tensions and Technology Series,* UNESCO, Calcutta, 1957.) The volume suggests that the only way to solve these problems of urbanization is to control the process of urbanization, and thus strike at the very root of urban problems in Asia.

The problems of growing towns are more serious in Asia because, as Hauser points out, "Asia is over-urbanised in relation to its degree of economic development' (p.9). Yet Asia has only 13 per cent of its population in cities of 20,000 or more, making it the least urbanised continent in the world except for Africa. The reasons for this seeming over-urbanisation are twofold; the historical pattern of development, and the present–day desire of these Asian countries for economic growth.

The colonial period, characterized by declining village industries in competition with cheap imported goods of the colonial powers and increasing population pressure in rural areas, gave impetus to rural migration to the towns. At the same time the colonial economic framework led to the establishment of "one great metropolis, the primate city, a great city which dominates the urban situation" (p. 87). These parasitic cities were orientated primarily toward the contribution of services to the colonial power abroad and to the needs of the colonial and indigenous "elite" in the great city itself. Their occupational structures were consequently heavily weighted on the side of tertiary occupations, which provided little opportunity for the relatively unskilled rural in-migrants. These had no alternative except to enter fringe tertiary occupations, such as hawking, which were already overcrowded. Thus today there are more people in these large cities than in any other continent and the problems of urban Asia are very much the problems of the big city.

The period of post-war independence and the desire of the Asian countries for economic development has also emphasised this trend, for in most of these Asian countries economic development must be accomplished through industrialization. The building up of the consumer and heavy industrial sectors will only increase this trend to concentrate people. Here the UNESCO Report, while admitting that there is no possibility of avoiding industrialisation, suggests that there may be other economic alternatives for the ordering of economic activities in a less concentrated pattern. The sum total of this uneven process of urbanisation and ineffectual methods of coping with the problems which have arisen has been a situation in which "urban misery and rural poverty exist side by side, with the result that the city can hardly be called 'dynamic' as social historians of developed countries generally describe the process of urbanisation" (p. 10). In fact the city proves to be a drag on economic development as its immediate requirements involve much more investment than "long term and less productive projects in the immediate sense" (p. 8). Thus limited capital resources are wasted at the all-important initial stage of economic development.

If the UNESCO volume's chief value rests on its emphasis of the wider implications of the relationship of urbanisation and economic development in the unique Asian context, of scarcely less importance is its outline of the social, economic and physical problems of the Asian city.

Problems of Asian urbanisation fall into three broad groups: the economic problems of unemployment, unbalanced occupational structures, poverty, inequality of income; the social problems of the in-migrant, the effect of the

city in breaking down traditional social relationships and the resulting problems of delinquency; the physical problems of overcrowding in slum areas, of town planning, of providing adequate transport and recreational facilities. These problems have existed for some time, and are increasing. This is emphasised by four recent publications on urbanisation in Asia: *The Indonesian Town* — a collection of pre-war studies on urban areas in Indonesia; Bopegamage's ecological study of Delhi (*Delhi: A Study in Urban Sociology*, Bombay, 1957); R. P. Dore's human study of social change in one small ward of Tokyo city (*City Life in Japan, London*, 1958): and Kaye's microscopic statistical survey of people and their living conditions in the overcrowded heart of Singapore (*Upper Nanking Street, Singapore*, Singapore, 1960).

That these problems of urbanisation were present and growing during the pre-war colonial period, is well illustrated in the collection of essays edited by W. P. Wertheim ("The Indonesian Town," *Selected Studies on Indonesia*, Volume IV, The Haugue, 1958), and in particular the study of "The Living Conditions of Municipally Employed Coolies in Batavia in 1937" carried out by Netherlands East Indies Central Bureau of Statistics, which points to indebtness (63 per cent of wages going to landlords, and "warong" keepers in payment of debts), and poor living standards in substandard dwellings — and this amongst a regularly employed group (p. 223). Why these conditions were allowed to continue and why scant attention was paid to them is brought out strikingly in other essays. The editor notes in the foreword that amongst "the Dutch ruling group there was an instinctive aversion to the phenomena of urban growth" (p. v), and it was only from individuals such as Westerveld ("a man of pronounced Socialist convictions" p. ix) that any agitation to investigate the bad urban conditions arose. Even when the Dutch ruling classes did begin to pay some attention to these conditions one wonders if it was not for fear of nascent nationalism rather than humanitarianism. This contention is supported by Karsten's persuasive argument to provoke government interest in the bad conditions of Indonesian towns. In his essay on "Town Development in the Indies," he says that people who live in "disorderly and unfriendly towns will be encouraged in a tendency to social discontent and unruliness. Hence the degree of aesthetic harmony and beauty in the Indies towns, though above all important from the idealistic point of view, also has a very concrete, in fact almost a political significance, from the realistic point of view" (p. 55). But little was done to solve such problems. The reason is explained by Karsten in a later section. "If the upper social stratum, which is so much more powerful than the others, goes its own separate way and is only superficially bound to the town and the other population groups, is it anything but a matter of course that it has created really satisfactory housing and recreational facilities only for itself?" (p. 68).

During the colonial period little attention was paid to the question of urbanisation. Only since the war has field work really focussed on the investigation and suggestion of remedies for the problems of urbanisation. The contemporary studies cited all draw attention to the social problems, of which a most important section is the process of social change. Here both Hauser, in the UNESCO Report, and Dore warn of the danger of carrying over concepts formulated in the Western city. The Asian city dweller is far from being characterised by sophistication, objectivity, utilitarianism and rationalism. Rural and traditional values strongly persist and this is well illustrated by the clusters of almost rural villages which contrast with the gleaming white and many-storied buildings in a city such as Kuala Lumpur. But even if the

process of social change is slower than in the Western city it still goes on—women possess more freedom; 'arranged marriages' decline and there is an increasing importance of the emotional relationship between husband and wife; the large joint, extended families tend to break up and become smaller. In Upper Nanking Street 64 per cent of the people live in simple families, i.e. parents and children only (p. 43, Kaye). If the larger allegiance to clan and tribe is partially broken down by the individualism of the city, the neighbourliness of the Western city is not always built up to replace it (Kaye reports that very few Chinese in Upper Nanking know people outside the house they live in; p. 276). Bopegamage comments that caste still affects neighbourliness amongst Indians in Delhi (p. 98). In Japan, Dore reports a rather higher degree of neighbour co-operativeness.

Social change brings its problems of adjustment. Particularly prone to them are the in-migrants who form a high percentage of city population. For instance, in Tokyo 42 per cent of the population are born outside the city (p. 18, Dore). In the Upper Nanking Street study, 41 per cent of the inhabitants were born outside Singapore (p. 141, Kaye), and these figures can be repeated in most large cities of Asia. The in-migrant faced with a new urban situation — with new and unfamiliar ways of making a living, regular working hours, an absence of family living and a large number of impersonal contacts — frequently fails to make adjustments and waves of delinquency and crime result. Often the problems of this initial period are avoided by the tendency of the in-migrant to stay with relatives.

This pattern of social change and social disruption must be seen against the physical framework of intense over-crowding of a high percentage of the population in slum conditions in the heart of Asia's cities or in shack settlements on the outskirts, which contrast with the spacious houses of the upper class and the "quarter acre cult" of the newly emergent middle class. It is with the physical problems of the overcrowded slum areas that the majority of writers are concerned. Bopegamage gives a figure for the density of population in the heart of Delhi of over one thousand people per acre (p. 40), but his analysis of living conditions and standard of housing is too subjective. Barrington Kaye has analysed the living conditions in intricate detail; the Chinese families living in Upper Nanking Street are huddled in tiny cubicles (subdivisions of the upper portions of the shophouses) each averaging 103 square feet and occupied by three or four people. The rooms are poorly ventilated (33 per cent have no windows) and practically all the people share cooking, toilet and washing facilities. It is not surprising that social and health problems arise under such conditions and that neighbourliness is at a minimum. Unemployment, low incomes and indebtedness also persist.

To solve these problems Bopegamage envisages replanning of the city; the creation of satellite suburbs, the clearance of slum areas and the control of the physical framework. Dore stresses the need to understand and direct the process of social change, while Kay is content to present the statistics assuming that they speak for themselves. It is only the UNESCO study which suggests that the solution lies in overall planning rather than piecemeal engineering.

The UNESCO report points out that Asia has two distinct advantages which should aid such schemes of overall planning. First, modern technology "offers a wider range of possibilities for the region-wide distribution of population" (p. 29). For example, "there is available for industrialisation and spatial arrangement of plant and population in Asia electric power as well as steam power, so that cities can simultaneously, rather than sequentially, experience centrifugal and centripetal forces" (p. 90). Secondly, Asia "has the advantage of the increasing role of government and public responsibility in the planning and

the development process." With these two advantages Asia could well take positive steps to guide the process of urbanisation.

The success of any such scheme rests on two basic requirements. First, that there is knowledge of the nature of Asian urbanisation. It is here that the intuitiveness of Hauser's essay on "World and Asian Urbanisation in Relation to Economic Development and Social Change" (UNESCO, pp.53-96), which surely must compare with Park's early 1920 essays on the Western City in opening up vistas for research workers, is of great value; so, too, are the solid case studies of Kaye and Bopegamage, and the microscopic studies of social change carried out by Dore. Likewise the efforts of the socialist Asian countries of North Vietnam and China to control urbanisation (only briefly treated in the UNESCO publication) must be more thoroughly investigated. These studies need to be repeated many times to build up the scanty knowledge of the conditions of Asian urbanisation. A second requirement for such a policy is substantial governmental control over all sectors of the economy. Governments can "exercise considerable influence in the location of industries by the building programmes, by granting permits for the establishment of retail trade and various other inducements" (p. 43, UNESCO). They can also help prevent rural-urban migration by the establishment of rural programmes which increase agricultural production, and decentralise industry with emphasis on small village industries. Such measures would certainly be concrete efforts to modify the process of urbanisation.

If these two requirements could be satisfied, and the advantages outlined above utilised, there is no reason why Asia could not attack the process of urbanisation. But allowing for the present world conditions of the cold war, and the economic commitments and policies of the majority of the Asian nations, it is unlikely that a policy utilizing all these suggestions will come about.

T. G. McGEE

SOUTH AUSTRALIA: WATER CONSERVATION AND SUPPLY

One of the most important problems successfully tackled by South Australia has been the provision of water both for its population and for its rural and industrial development. The magnitude and reliability of the distribution systems constructed reflect keen foresight and intelligent planning by the State authorities and a battle won over natural conditions unfavourable for the impounding and storage of water.

The main task in water conservation and water supply consists of collecting and conserving the water available in the places where the supply is sufficient. Unfortunately South Australia has few such places. Only four per cent (15,000 square miles) of the State receives an average annual rainfall in excess of 20 inches, whereas 83 per cent receives a rainfall less than ten inches. The actual proportion of the rain contributing to stream flow is very low. For example, the average run-off from the watershed of the River Torrens is only 16 per cent (J. R. Dridan, 'Developing South Australia's Water Resources, with Special Reference to the River Murray,' *Journal of the Institution of Engineers*, 27, 3, March 1955). Average annual river flow of the Myponga River is only approximately 4,000 million imperial gallons, although the average rainfall reaches a maximum of 36 inches in the 45 square miles catchment (*Myponga Dam and Pipeline*, The Engineering and Water Supply Department, 1955, Adelaide). Several factors combine to cause this loss, but the two most important appear to be evaporation and percolation. Loss by evaporation in any part of South Australia is probably never less than 36 inches

and in many localities it may exceed 100 inches (The Engineering and Water Supply Department, 'Water Supply in Country Districts,' 1960. Revision of the article published, *Education Gazette*, July 1955, South Australia). Because of this high evaporation rate much of the winter rain is absorbed by the soil before there is any appreciable run-off.

Two areas of South Australia are regarded as self-sufficient in so far as water is concerned. First, the dry northern areas which obtain their water from artesian basins, shallow water bearing areas and artificial storages constructed as required. It is economically impracticable to convey water into these areas unless needed for important industries and settlements, as in the case of Woomera. Second, the southeast of the State where the rainfall is higher (over 20 inches) and is supplemented by sub-surface water flowing from Victoria. Although this area has surplus water available it is unlikely that any export will be attempted. Instead it is far more probable that industrial undertakings requiring large volumes of cheap water will be encouraged to develop in this region.

The primitive methods of water supply and distribution in early Adelaide were quickly abandoned after the establishment of responsible government. By the turn of the century both the Torrens and Onkaparinga Rivers, the two main rivers draining the western slopes of the Mount Lofty Ranges, had been exploited and three reservoirs, Thorndon Park, Hope Valley and Happy Valley, supplied water to Adelaide. These reservoirs were followed by Milbrook in 1920 and Mount Bold in 1938 and the combined capacity of the metropolitan supply reservoirs thus reached 14,000 million imperial gallons by the outbreak of the 1939-45 War. Following the termination of hostilities the consumption of water in Adelaide rapidly increased because of the rapid increase in population and because of the increase in the consumption per capita. Between 1947 and 1954 the population of the metropolitan area increased by 26.4 per cent and the consumption per capita by 21.7 per cent. While total water consumption was well under 8,000 million imperial gallons in 1938, it was over 19,000 million imperial gallons in 1957 (J. R. Dridan, 'The Harnessing and Use of South Australia's Water Resources' in *Introducing South Australia*, 1958, Adelaide, pp. 219-234).

As a measure to overtake the leeway which had developed through the cessation of civil construction during the War, the Mannum-Adelaide pipeline was constructed. Subsequent detailed examination of further available water resources around Adelaide revealed that two new streams offered advantages for immediate development. The new reservoirs on these streams, South Para — now completed, and Myponga — under construction, will initially increase the metropolitan firm annual water resource to approximately 28,000 million imperial gallons. However, as the reservoirs are also planned to provide for the expanding demand in their own areas, it is certain that the quantity of water available for Adelaide will seriously diminish with the increase in intermediate diversions. Thus the search for, and development of, new water sources must continue if Adelaide is to maintain its present rate of growth. Besides the enlargement of the retaining wall of Mount Bold Reservoir, future plans include the possible construction of additional reservoirs at Kangaroo Creek, Clarendon, Baker's Gully, Finniss Creek, Little Para River and Sixth Creek (The Engineering and Water Supply Department, 'The Metropolitan Water Supply, 1960. Revision of the article published, *Education Gazette*, March 1955, South Australia).

The only river of any magnitude in South Australia is the River Murray. For many years the river water has been used for irrigation and domestic pur-

poses by areas within and adjacent to the valley. In 1915 the River Murray Waters Agreement was ratified between the Commonwealth and the three interested States and this guaranteed South Australia a minimum monthly water flow in normal years and a fixed proportion of the water available in drought years. Under an amendment of the Agreement South Australia completed in 1940 the construction of five barrages across the channels connecting Lake Alexandrina with the sea and thus turned the lake, with Lake Albert, into a freshwater body and prevented sea water from entering the lower reaches of the River Murray. This created for the State an additional source of water. With the construction of a pipeline from Morgan to Whylla in 1944 the State entered upon a new phase in water development.

Two pipelines at present draw water from the River Murray, namely the Morgan-Whyalla pipeline and the Mannum-Adelaide pipeline. The construction of the pipeline from Morgan to Whyalla, a distance of 223 miles, was undertaken mainly to provide adequate water for the expansion of the Broken Hill Proprietary Company's activities and the parallel growth of Whyalla. Apart from its contribution to Whyalla the pipeline also supplies water to the Bundaller and Beetaloo water districts, to Woomera via a branch main, and to several mid-north centres. Although the capacity of the scheme is of the order of 2,000 million imperial gallons, the continuing development at Whyalla has made it obvious that in the future more water will be needed from the River Murray and plans have already been announced for the duplication of the pipeline. The Mannum-Adelaide pipeline was completed in 1954 and was designed to meet the rapid increase in the city's demand for water in the immediate post-war years. It not only delivers water to Adelaide through the River Horrens reservoir systems, but also supplies water to rural areas en route, and to other branch mains. The annual capacity is 14,600 million imperial gallons and this is being increased by the addition of further pumps. It is probable that by the time the population on the Adelaide Plains has reached 700,000 a further pipeline from the River Murray will be needed ('The Metropolitan Water Supply,' 1960).

Ninety per cent of the population of South Australia now depends wholly or partly upon Murray waters and there is little doubt that the State's future development will continue to be closely bound up with the river. Thus it is not surprising that South Australia should show more than a passing interest in the tremendous Snowy Mountains Scheme. Diversions from the Murray are not yet approaching the quantity available from this source but proposed schemes must carefully weigh the following: the Murray is not inexhaustible; high costs are involved in pumping water to heights of 1,500 feet to take it to areas west of the Mount Lofty Ranges; and the situation will eventually arise 'when each gallon of water pumped to remote areas for domestic, rural and industrial use will mean one gallon less for irrigation within the Murray Valley' (Dridan, 1958, p. 221).

Country towns and rural areas obtain their water supplies by a variety of means — from reservoirs supplying extensive distribution systems, from subsurface sources or from the River Murray.

The first large country scheme, the Beetaloo scheme, was completed in 1890 and supplied water to Port Pirie and to Kadina, Wallaroo and Moonta. This scheme was eventually connected with the Bundaller and Baroota distribution systems. Augmentation of the supply capacity by water from the River Murray has enabled the reservoirs to serve not only the farming areas of the mid-north, but also a large area in Yorke Peninsula which contains some of the best cereal producing land in the State. Total consumption has in-

creased rapidly during the last 20 years. In the period 1934-38 the amount of water supplied averaged 190,000 imperial gallons per square mile per annum, while in recent years it has reached 310,000 imperial gallons per square mile per annum ('Water Supply in Country Districts,' 1960).

The supply and distribution of water on Eyre Peninsula deserves special mention. Of its 32,000 square miles only 1,000 square miles has a rainfall of 20 inches or more. The first conservation scheme began with the construction between 1912 and 1914 of dams at Yeldulknie, Ullabidinie and Ulbana and was designed to provide water for the local farming country. This was followed in 1922 by the Tod River Scheme, one of the greatest achievements in Australian water conservation. In this scheme water is pumped from the Tod River Reservoir to a service reservoir on Knott's Hill and then gravitates 241 miles to Ceduna, distributing water to farms and townships on either side of the trunk main. Pipelines also connect with the Yeldulknie system and with Port Lincoln. Once again it was not long before the demand outstripped the supply. Particularly valuable as an augmenting source of supply is the Uley-Wanilla artesian basin. Although its area is only 20 square miles, approximately 500 million imperial gallons annually can be obtained and conveyed to the Tod River reticulation and to an extensive area on the eastern side of the peninsula previously in urgent need of water.

Many of the river towns are served with water from the Murray. Tailem Bend, Murray Bridge, Mannum, Morgan, Loxton and Renmark all draw water from the river, while Milang and Meningie are supplied from Lake Alexandrina and Lake Albert respectively. Usually the water is pumped to storage tanks and then gravitates through reticulation systems.

Capital invested on water supply works in South Australia amounts to approximately £(A.)60 million. The State proudly claims two achievements: the proportion of the population (95 per cent) receiving water by reticulation is one of the highest in the world; and no industry has been forced to turn away from South Australia through doubts as to whether sufficient water would be available for its processes. South Australia's ultimate development will probably depend upon the quantity of water that can be assured per annum and consequently it can be assumed that the State will not rest until every available water source has been thoroughly explored and exploited.

BRYAN SAUNDERS

NEW ZEALAND: PROBLEMS OF A 'COLONIAL' ECONOMY

'An economic historian engaged in putting the countries of the first half of the twentieth century into groups would take one look at New Zealand's exports and immediately place us in the economic category of 'colonial'.... (W. B. Sutch, 'Programme for Growth' p. 6, *Background Papers, Industrial Development Conference June* 1960, Government Printer, Wellington, 1960); an unorthodox view considering that New Zealand has one of the highest per capita income levels in the world, a fairly elaborate social security system, a highly urbanised population, with only 17 per cent of her labour force in the primary section. Nevertheless her 'exports are massive quantities of raw materials and comparatively unprocessed foodstuffs' (p.6) and she is dependent for her overseas earnings upon this small range of primary produce which is sold in a very few markets. In 1959 butter, cheese, meat and wool provided 85 per cent of the total £(N.Z.)305.9 million received from exports, whilst the United Kingdom accepted almost 60 per cent of these exports. Britain, with U.S.A., France and Australia accounts for nearly 85 per cent of the total exports. The

prices of these exports are subject to variations over relatively short periods and the terms of trade are rarely in New Zealand's favour, the result is a tendency towards marked instability in the economy, an instability incompatible with the widely accepted policy of full employment. Furthermore the rapidly increasing population must find an outlet in the non-agricultural sectors, but every increase in manufacturing capacity is liable to require more overseas assets to import the semi-finished materials for processing and assembly, so that when 'foreign exchange is short it becomes necessary to cut sharply the supply of imported materials for too many industries' (p. 14). Indulging in some economic hyperbole W. B. Sutch places New Zealand, in its international trading context, with Ghana, Malaya, Cuba, Bolivia and Venezuela. Whereas New Zealand despite years of self government has continued in its colonial economic status, he cites Malaya's refusal to rely on 'international specialization in a world where economic doctrines once taught in England cannot apply' (p. 17) and her recent attempt to build an industrial counterweight to her vulnerable rubber and tin economy. He dismisses the prospect of a free trading world, rejects the philosophy behind GATT, whilst underlining the growth of State directed economies in the world and touching upon the fear in New Zealand of regional economic groupings. If, he argues, New Zealand remains content to rely on its farming industries '... it faces falling living standards and a falling population ... and ... will remain a country with many colonial features while other former colonies ... are rapidly bringing a balance to their social and economic life' (p. 18).

In his opening address to the Conference the Rt. Hon. Walter Nash briefly commented on his own work in bringing an element of stability into the economy, but went on to recognise that for the 1960s '... it is time to shift the emphasis from security and stability ... and to direct our own efforts towards economic growth' ('Building the Future,' p. 7). With this in mind he announced the Government's aim 'to encourage the development of industries which can process New Zealand or imported raw materials in their crudest form through to their most finished stage' (p. 14). At the same time new resources are to be explored and new skills developed. To remove any doubt that growth might be a painless affair, Sir Douglas Copland, whilst stressing that a policy of *laissez faire* is no longer requisite to New Zealand's position and advocating a long term plan, suggested that the ratio of investment to gross national production should approach 30 per cent ('Economic Problems for New Zealand in an Expanding World,' p. 7). With these preliminary statements in mind and with the benefit of the information contained in the 41 Background Papers, plus a useful number of statistical appendices, the delegates to the Industrial Development Conference broke up into three committees to produce on the fifth day their Report (*Report Industrial Development Conference, June* 1960, Government Printer, Wellington, 1960). The Background Papers have inevitably a wider appeal than the Report and they provide a topical and detailed picture of New Zealand economy. The papers fall into four groups: those dealing with the primary industries and the development of natural resources (inevitably a short section); those dealing with questions of transport and distribution; a third section devoted to overseas trade and associated problems; and a fourth and longest section covering a whole range of industrial topics.

R. M. Hutton-Potts takes up the question of the regional distribution of industry (Background Paper 21) and argues for 'a pattern of industry spread throughout the country.' The basis of his argument is apparently the growing concentration of the population in the North Island. (At the turn of the century the North Island possessed half of the total population, by 1921, 61 per

cent and by 1956, 67 per cent.) But his argument is weakened by the fact that no obvious detrimental effects have appeared from this swing of population to the north (the functioning of the Welfare State itself is, in part, responsible for this), and it is very difficult to foresee how industry can be spread when the population is continuing to cluster around the four main centres. Hutton-Potts appears to fall into the common error of confusing geographical spread and economic-demographic spread. Any case for the decentralization of industry needs to take account of the future employment problems of the strongly Maori areas, but this points to the need for more industry and decentralization in the North not the South Island.

Appreciating this problem Noel J. Wood writes 'We cannot afford to allow Maori population to pile up in backward rural areas which are incapable of carrying any great concentration of people.' Without referring to the very great difficulties involved in the industrialization of the Maori, he continues, 'We could be committing a supreme folly if we pursued overseas immigation to the point of creating a racial problem of underemployed Maoris . . . while the immigrant labour filled the vacancies for labour in other areas' ('Immigration and the Labour Force,' Background Paper 26). Committee III reporting on Human Resources recognised these claims on behalf of the Maoris but urged an annual intake of 15,000 or 20,000 immigrants over the years 1960-4, the emphasis to be upon skill, and technologists, technicians and teachers. Significantly, for a country preferring the 'Nordic races,' the Committee recommended the 'choice of immigrants should not be restricted to certain nationalities if others can provide the skills (although the preference for British and particular persons is expressed)' [*sic*] (Report, p. 133).

The New Zealand factory is characteristically a small factory, 30 per cent of the labour force is employed in factories employing 20 people or less; an equivalent proportion works in factories of 100 or more persons. In the period 1956-8 the proportion engaged in the smallest factories, 20 or less persons, declined slightly, whereas the 100 plus group increased from 30.2 per cent to 35.8 per cent; notably the increase has occurred in the 200 and over group (W. Fisher, 'Ownership and Control of Industry in New Zealand Manufacturing,' Background Paper 34). Comparing the value of output per person by size of plant, '. . . . there appears to be a danger zone for many factories. They can be efficient with up to 50 workers. Beyond that number there is a loss of efficiency which is not overcome until they move on to the over 200 class.' The implications of this to the future of manufacturing are worthy of consideration because 'There appears to be a case for rationalization in some industries where mergers would make possible economies of scale and the use of capital equipment to manufacture in depth,' otherwise, 'The danger is that if there is not rationalization in some fields overseas firms may move in and absorb existing companies.'

A cautious attitude to overseas control and investment was expressed in other papers such as W. Rosenberg's ('Financial and Monetary Policy and Capital Requirements for Industrial Development in New Zealand,' Background Paper 37), and also by Rt. Hon. W. Nash: 'We are not anxious to have industries in New Zealand which are fully owned and therefore controlled overseas . . .' It might surprise Gunnar Myrdal (*An International Economy*, London, 1956), to find such an antipodean application of his viewpoint and in a country not usually considered as underdeveloped. However no one could complain of the freewheeling ideology that abounded at the Conference. On the one hand the absence of the competitive spirit in industry and business was deplored; 'it would be difficult to find another country with as rigid and pervasive limitations on competition as those that have existed in New Zea-

land. Restrictive trade arrangements go with stagnation, they limit the introduction of new techniques, they create inefficiency, they raise costs, and they are antagonistic to development' (W. B. Sutch, p. 21). On the other hand the functioning of price mechanism itself seemed to be questioned. 'The Conference considered that some measuring stick is needed to assist in the aim of encouraging the allocation of resources into the most efficient uses' ('Summary of Reports,' 6. 83, *Report*). One can only surmise that the full implications of this statement were overlooked by the eighty delegate bankers, wholesalers, retailers and manufacturers who attended what was in many ways an unorthodox Conference.

S. H. FRANKLIN

Geographical Reviews

THE ALIEN EYE

Richard K. Beardsley, John W. Hall, Robert E. Ward, *Village Japan*, The University of Chicago Press, Chicago, 1959, pp. xiv, 498, Illus., Maps, Glossary, Index, $8.75.

Village Japan is a detailed study of the buraku of Niike, a rural hamlet of 24 houses, located on the Okayama Plain on the main island of Honshu. Field work was undertaken by a diverse group of specialists, under the auspices of the University of Michigan's Centre for Japanese Studies.

For this geographer at least, this is the most important book about postwar Japan. The volume attempts to cover every activity and organisation in Niikè. Thus its scope is tremendously wide and in its 498 pages it deals with the history, geography, economy, sociology and political life of the hamlet and relates these to a wider environment. There is an excellent chapter describing the material goods and equipment of the village which, even for those with first-hand knowledge of Japan, contains much new information. The chapter 'Land and Water' emphasises the close relationship of water supply and rice agriculture. Water control is of such paramount importance that to handle the long-established intricate irrigation system the buraku is joined cooperatively into a large common law organization transcending even prefectural boundaries. In the chapter 'Niikè at Work' land use and agricultural techniques are very well illustrated and a short section describes non-agricultural occupations. Although certain aspects of the community are illuminated with brilliant clarity, as is almost inevitable in a book of this size, parts will appeal only to the specialist. In the last three chapters an attempt is made to show the place of Niikè in the larger community, but the connection becomes tenuous and one is overwhelmed by the complexities of local government, political processes and religion.

The book gives a picture of a Japanese rural community before the full impact of modern life has impinged upon it. The household is the prime unit but the collective households are also a communal entity and the community is more important than the family except in times of extreme stress. Male primogeniture is customary and marriages are arranged. Thus the traditional is more important than the modern in social relationships, but the beginnings of change are suggested by the description of the high school graduate who wished to become a typist. Despite her mild attempt at self assertion this girl expected that she would accept her parents' choice and marry a farmer. In future with increasing pressure from the cities, individual choice will probably take precedence over traditional practice.

Repatriation of nationals from overseas after the War, the occupation of the country, land reform, land consolidation and a multiplicity of technological improvements have had an impact on the community which the survey fully describes. One question remains unanswered. What effect did the large team of investigators have on Niike even before the end of the study? A comprehensive research project such as this cannot be made at an instant of time. Whilst the study was in progress (it continued over seven years) changes took place, changes undoubtedly accelerated by contact with the Americans. Evidence for this is in the autobiographies of the two women, in which one of the most important events in their lives was the contact with the study group. Consequently the 'typical' nature of the village may have been slightly invalidated. Did John Embree get a more valid view of Suye Mura? Would local specialists have certain advantage in this respect?

Technically the publication is of excellent quality, the photographs grouped into one section are good and the mapping is outstanding. Particularly pleasing and informative are the high perspective line drawings. But the use of the book for reference is hampered by the omisssion of footnotes and a bibliography. A real deficiency is failure to refer in detail to the field notes which we are informed are held at Ann Arbour, Michigan.

This fundamental book is important not only for its description of Japanese rural life but also because it indicates that a real contribution to the understanding of one cultural group can be made by the people of an alien culture. Perhaps the objective, perceptive eye of the outsider is required to see a community in its true perspective. Despite the large numbers of competent Japanese specialists working in this field none has been so successful as these writers in depicting his country to the West. It is obviously still valuable for Westerners to do field work in Japan and we would doubtless gain if Japanese scholars made a similar study of a Western community.

J. W. MACNAB.

MULGA AND MESQUITE

H. C. Allen, *Bush and Backwoods: A Comparison of the Frontier in Australia and the United States*, Michigan State University Press, East Lansing, 1959 pp. 153. $3.50.

Many historians, and not least those of Australia, are sceptical of the value or validity of the frontier hypothesis. They have equated its findings with environmental determinism, and because in the main they prefer social determinism, if determinism there must be, tend to discount arguments in its support. The frontier of settlement in Australia was never the visibly apparent social crucible that it was in America. There, Census officials were able to plot, decade after decade, the steady westward progression of the line of population density above two persons per square mile and thus give Turner statistical backing for his ideas. Even today the line of comparable density in Australia stands nowhere more than 200 miles from the coast, and to this distance only in parts of the east and south. If this is the mark of the frontier, then either Australia has scarcely had one, or most of the country is still beyond it.

Allen's enlightening discussion, therefore, starts with the initial handicap that there is just nothing in Australia comparable with the American frontier, for irrespective of its other qualities a frontier must by definition have location, must be a line of demarcation and separation. In this sense, the only Australian frontier was that of the great pastoral expansion, for in this exceedingly rapid progression of settlement across the continental space the occupied was always

separated from the unoccupied in fact if not in law. But to say, as Turner maintained of America, that Australian society underwent "perennial rebirth" with the forward movement of the pastoral frontier is contrary to fact. The miners came later, and their activities could hardly be termed frontier activities. Allen himself implicitly recognises this type of difficulty when he says of the irrigation farmers that theirs was "not properly a frontier phenomenon," (p. 81) because the frontier had long since passed when irrigation began. If the term frontier is to be applied to more than spasmodic phases of Australian history there must clearly be a redefinition of the word itself.

All this makes one wonder whether the Turner discussion should not simply be labelled the New Settlement hypothesis, and forget about the word "frontier." Australian historians have long been conscious of the fact that in the process of settling the land there were a number of subtle changes wrought in the pattern of folkways, and perhaps even in philosophical attitudes. But the argument that rural settlement was a primary force in stimulating democracy neglects the powerful Irish and convict "agin the government" attitude of the majority of the early settlers, and the influence of imported Chartist ideas. These things were grafted into Australia with its people not grafted on to the people by Australia. Because Allen recognises this flowering of democracy as one of the prime similarities and because, contrariwise, many European historians correlate the rise of democracy with urbanisation, one is left in a quandary as to the precise comparisons that can be drawn between the results of the settlement process in the two countries.

But the book does succeed in providing a useful summary (an essay, in the author's words) of published Australian literature on the effects of settlement in a strange land on a European people. Because a good deal of this material is argument rather than proof it gives an inevitable bias to the conclusions of the essay. This is not to say that it does not provide useful insights, although most of these naturally come from the sources quoted. However, the comparison between Australian pastoral expansion and the westward movement of the cotton belt in the American South, both extending their domains through the power of a mainspring located on the coalfields of northern England, is a useful one. The introductory chapter on the differing geographical circumstances of the two areas is valuable, even if the included facts are more than familiar to geographers and historians alike. The similarity in the treatment of native peoples in the two areas is remarkable, and duly noted. And the warning that cities are important in moulding national character is certainly well taken.

Here one must point out a curious deficiency in Australian historiography that finds its reflection in the book. In his concluding section Allen notes that "the self-reliant, optimistic, ingenious, individualistic, independent American of the pioneer *farmer's* frontier was markedly different from the socialistic, sceptical, rough-and-ready, "mate-conscious" collectivist Australian of the rural *wage-earner's* frontier" (Reviewer's italics). But surely if a comparison of frontier influences is to be valid it should be made between similar categories of people in the two countries. So little has been written about farmer settlement in Australia that this might be excusable in Allen's case, limited as he was in terms of time to make his study. But that such a hasty comparison was indeed made suggests that the matter has not been closed by this book. Of the Australian farmers it is probably true to say that on all counts except that of optimism they paralleled their American counterparts within the framework of their society; and even in the case of optimism, were not the Australians always pushing into "better country further out?"

This book is a valuable contribution to comparative historical study. Its shortcomings stem from basic deficiencies in its source material, and not from the methods used. It is extremely interesting, and the ideas put forward are stimulating even though they require further investigation.

A. J. Rose

ADDITIONAL RESOURCES

Five new maps for the *Atlas of Australian Resources* are now available from the Department of National Development at Canberra. The maps, each accompanied by a commentary, are entitled *Croplands, Geology, Immigration, Mineral Industry* and *Manufacturing Industries.*

Four separate maps comprise the map-sheet *Croplands,* viz., Wheat Acreage, Wheat Yield, Other Major Crops and Minor Crops. The two most interesting are of Wheat Acreage and Wheat Yield for they emphasize two important post-war developments in Australian wheat growing; first, the general decline in total acreage under wheat, and second, the increase in yields per acre. The other maps cover all the important farm crops, including field crops, market garden crops and those of orchard and vineyard.

In handling the presentation of the data the compilers have shown initiative in combining various cartographic techniques. However, it is to be regretted that in three instances colour employment shows a disregard of appropriate procedure. First, the graded representations for the percentage decrease or increase in the acreage under wheat and for the average yield per acre are technically incorrect and this detracts from the visual impression. Second, it is difficult to determine the distribution of sorghum. A far better effect and a greater degree of legibility would be obtained if the dot colours of sorghum and sugar cane were interchanged. Third, the yellow symbols for plantation fruit, flax and canary seed are not successful. With one possible exception, the necessary background and environment contrast is not present and consequently it is difficult to identify the symbols.

The surface geology of Australia is shown on a scale of 1:6,000,000. The map-sheet *Geology* is essentially a brief geological history of the 'fossil continent' from about 3,000 million years ago to the present. Easily identified are the three physiographic regions of Australia. In the main the Great Western Plateau, covering about 2 million square miles, is based on a Pre-Cambrian shield; the Central-Eastern Lowlands, generally below 500 feet, on level-bedded deposits of late geological age; and the Eastern Highlands, a great belt of elevated land with a complex geological history, on Palaeozoic formations. Correlation with the map-sheet *Mineral Industry* emphasises that, as in other parts of the world, some of the richest mineral provinces are associated with the Pre-Cambrian shield.

The compilers must be congratulated on the success of their colour selection. In the choice of single colours they have achieved forms which represent clear-cut expressions of the colours used, while in the choice of colour differences they have achieved colours which aid considerably appropriate identification. However, one criticism and one suggestion seem in order. The criticism—all the categories on the map-sheet are differentiated by purely hue contrast and no attempt is made to utilize value differences. It is safe to assume that colour, with all its alleged attention advantages, reaches saturation point when displayed with many variables of the same type. To avoid this, interest should be created through variety, or in other words, through change in colour form. The suggestion—superimposed symbols can effectively reduce (and this

is often desirable) the number of colours employed on a map. For example, the Tertiary deposits could be profitably represented by one colour if superimposed symbols were used to differentiate between the basalt volcanics and the alkaline volcanics. This procedure would provide a connection (colour) and a distinction (symbol) between the deposits.

Four maps depict the distribution of 1947-54 immigrants and the immigrant contribution to population growth between 1947 and 1954 (map-sheet *Immigration*). Although immigration has been an important factor in population growth throughout Australia's history, it is the latest influx of migrants (1,007,000 net intake between 1947 and 1958) that is particularly impressive for it is contributing substantially to a remarkable upsurge in the present rate of population growth. The impact of this influx on the population age structure is admirably described by J. Zubrzycki in the accompanying commentary. Post-war immigration to Australia has conformed to the characteristic trend towards increasing urbanization. For both Sydney and Melbourne the contribution of immigrants to urban growth betwen the censal years was in excess of 60 per cent of the absolute growth.

The reviewer would like to have seen represented, first, a percentage breakdown for the State capitals of immigration according to birthplace, and second, a regional analysis of ethnic settlement. Much interesting information would thus be presented. Generally immigrants from Eastern Europe show the highest degree of urban concentration, while those from Scandinavia, Italy and the Netherlands show a significant rural dispersion. Italians are the most important immigrant group in north Queensland (in 1954 they constituted exactly one half of the total of oversea-born persons). Both the British component in the Latrobe Valley and the Netherlands component in the Wollongong-Port Kembla area underwent striking increases between 1947 and 1954. The colour work in the urban maps is both pleasing and effective. However, in the rural maps two procedures call for comment. First, the colour change drafted to differentiate between rural areas with a population of less than one person per square mile and rural areas with more than one person per square mile is not successful. An isoline would have been far more functional. Second, the graded colour schemes used in these maps were unsatisfactory. In this type of representation more emphasis should be placed on intensity changes of one hue rather than changes in hue.

The map-sheet *Mineral Industry* draws attention to the important part mineral production plays in the Australian economy. Black coal is obtained in all Australian States, although New South Wales has the lion's share, accounting for 75 per cent of the total production. It is clear that further expansion of the manufacturing industries must depend upon the development of mineral resources and it can thus confidently be expected that the near future will see an increasing realisation and appreciation of the continent's mineral potential. At the present time Australia is in the happy position of producing most of her own mineral requirements as well as being an important exporter of a number of minerals.

The map, drawn to a scale of 1:6,000,000, exhibits a high standard of draughtsmanship. Proportional symbols represent the value of mineral production and also indicate the treatment stage (unfortunately some of the lettering associated with the smaller symbols is difficult to read); flow lines indicate the mineral movements to principal treatment and consumption points; and colours show the main metalliferous areas and ore provinces.

The importance of manufacturing industry in the Australian economy is clearly indicated in the nine small maps of the map-sheet *Manufacturing Industries*. The centre map depicts Employment in the various manufacturing in-

dustries, while the other maps show the distribution and size of eight groups of selected industries. Four features deserve to be mentioned. First, most manufacturing industries are concentrated in the State capital cities, although important exceptions located in provincial centres or on coalfields do exist. Second, New South Wales, with 41.5 per cent, and Victoria, with 33.5 per cent, are the dominant manufacturing States and employ nearly 790,000 or 75 per cent of Australia's total factory working population (1,057,000). Third, the present gross value of Australian factory output exceeds £(A)4,000 million and is about a third greater than the value of production of all primary industries. Fourth, only 18 per cent by value of imports are now in the form of finished consumer goods.

The map-sheet is another example of good draughtsmanship. In the first place a tremendous amount of activity has been successfully presented in a limited part of Australia, and in the second place the arrangement and selection of colours is probably the finest devised by the Department of National Development. One change in technique would have been appreciated, namely the replacement of the divided circles by bar diagrams. With the present system of representation comparison between the main centres (such as Adelaide and Newcastle) of employment in the various manufacturing groupings is not easy and unfortunately the accompanying commentary does not present a detailed analysis of this information.

BRYAN SAUNDERS

BEACHCOMBING IN WHITEHALL

W. P. Morrell, *Britain in the Pacific Islands*, Oxford University Press, London, 1960, pp. ix, 454, 55s.

In this book Professor Morrell has written of British influence and activity, official and otherwise, in the broader context of European penetration of the Pacific islands. In doing so, he has largely excluded Hawaii and New Zealand, from whose history he might have taken themes closely relevant to those of some of the territories on which he has concentrated; and, perhaps contrary to what his title might suggest, he has dealt principally with events of the nineteenth century, devoting only a brief chapter, by way of an 'epilogue,' to 'The British Pacific Islands in the Twentieth Century.' As a further limitation, the author has relied mostly on printed sources, a notable exception being his use of the Pacific Island Series Foreign Office 58. To have covered all of the original records, he states in his preface, would have been too great a task; and besides, had he attempted it, he would have been overwhelmed with data and would have defeated his purpose. Instead, he has endeavoured to consult the manuscripts 'at points where it was impossible otherwise to understand what was happening.'

Professor Morrell is surely right about the difficulty of combing through the vast and dispersed Pacific literature. At the same time, the existing bibliographies are not comprehensive enough to enable the author of a general work such as this to select, with facility, the bulk of the available material bearing on his subject. The same problem will, of course, affect the judgment of readers, and so it must be specified that the following comments are to apply in particular to sections of this book dealing with Polynesia, the present reviewer's special area of study. With this understood, it may be noted that, while Professor Morrell's declared interest centres 'not in Downing Street but in the islands,' he seems to have passed up or used only sparingly many of the sources most cogent to his purpose, and to have embraced many others

which focus more on external interests than on actual conditions in the islands. Such is the disadvantage of depending on selected sources for clues to govern the sampling of the rest that this book not only lacks reference to many known developments of importance and skimps detail in respect of others, but sometimes takes little account of conflicting evidence on matters controversial or complex.

Printed missionary sources, which the author describes as a 'formidable mass of first-hand evidence,' are often less reliable as historical records, because of their elements of propaganda, eulogy and self-justification, than are the manuscripts, especially the diaries and journals. Indeed, without recourse to the latter it is scarcely possible to document some of the most significant aspects of mission activity, including the missionaries' interference in local politics, their differences regarding the form and conduct of government in the Pacific, and their handling of questions of imperial intervention. On all of these counts Professor Morrell's chapter 'The Polynesian Missionary Kingdoms' is deficient.

A statement in the same chapter (p. 47), to the effect that the first resident missionaries in Rarotonga 'managed to unite the three tribes under a single code of laws,' suggests a centralized political order which was not in fact achieved and, in turn, recalls a major problem confronting Pacific historians—how to acquire sufficient understanding of the indigenous societies and the aspirations of their members to facilitate analysis of 'culture contact' situations. The author has emphasized, in this regard, the value of consulting anthropological treatises and of visiting the islands, even though certain conditions there may have changed radically over the years. But not less useful, particularly in respect of Polynesia, is the testimony of the islanders themselves, which is often found in the native languages and, for the most part, in manuscript form only. This large body of material, which Professor Morrell does not mention, dates well back into the nineteenth century and throws light on many subjects, such as chiefly authority, land alienation, and the formation and identity of native political factions, that European observers, perhaps from self-interest as much as ignorance, tended to misinterpret or over-simplify. It is partly from neglect of what the islanders had to say that histories of Samoa, for example, have been so vague about the forces operating from within that group—so prone to name sects and political alliances without explaining their origins, composition and aims, or to stress the clash of foreign interests without revealing the local conditions that contributed to it.

Also of value to the island-oriented historian are the consular post records, which include much material, notably in reference to commerce and political development, that is to be found nowhere else. Of a rather similar nature are those archives of island governments to which scholars may gain access. To take a final example, what of the newspapers published in the Pacific area? These—*printed sources*—are seldom cited by Professor Morrell, yet they are among the richest mines of local news and information.

In the opinion of this reviewer, then, this book, whatever the compelling reasons, leaves too much data unexplored to be considered adequate as a study 'centred . . . in the islands.' That the author has so described it is unfortunate, for it is still probably the best survey of European elements in the recent history of the Pacific. More order might have been imposed on the material, e.g., by drawing sharper comparisons and contrasts between developments in different islands, but better the present form than synthesis round a theme such as 'minimum intervention' or overuse of the concept of 'international rivalry', which Professor Morrell has taken pains to avoid.

R. P. GILSON

LOST — THE PACIFIC

B. W. Sparks, *Geomorphology*, Longmans, London, 1960, pp. 371, Illus., Index 50/-

In the literature of geomorphology there are some famous examples of the pure art of exposition, by men who added to a clarity of word an equal clarity of diagram and sketch — Davis himself, Cotton, Wooldridge, Strahler. Mr Sparks continues the orthodox approach to the study of landforms in the sequence which experience has shown to be sound, working from weathering through slopes to rivers and river systems and so on. His explanations are clearly worded, he avoids jargon where possible, but his diagrams, though adequate, are not in the same class as the sequential series which makes, for example Strahler's *Physical Geography* so valuable for first year university geography students.

This book is obviously aimed at British students, for the author gives a detailed chapter on the influence of rocks on relief which is clearly intended to make their own landscapes intelligible to them. In accord with modern views he has a special chapter on the development of slopes, where he enumerates some sound sense, in particular on the difficulty of applying statistical method where so many factors, particularly historical ones, are quite unknown. A chapter on the importance of changes of climate bears on this problem but its length of only five pages may reflect rather the lack of soundly based information than small interest on the author's part, for this difficult field is more and more coming to be seen as the key to the interpretation of the present landscape.

But a New Zealander puts down the book with a vague feeling that something is wrong, and then realises with a start what it is. Nowhere is there any discussion of a landscape in active tectonic movement, that landscape which is so much a part of the rim of the Pacific. The bearing of tectonic movement on landforms, the knowledge it has given us of the timing of erosive processes, the whole pattern of transcurrent faulting as it affects landform, simply do not exist for the author, in spite of the abundant geomorphological literature which deals with them. This, in view of the detail in some other chapters, simply leaves the reviewer completely at a loss.

D. W. McKENZIE

THE WOOD AND THE TREES

Julian H. Steward and Louis C. Faron, *Native Peoples of South America*, McGraw-Hill, New York, 1959, pp. 481, Maps, Illustrations, Index. $8.50.
Oscar Lewis, *Five Families*, Basic Books, New York, 1959, 350, pp. $5.50.

Though it is most appropriate for readers of *Pacific Viewpoint* occasionally to glance across the Pacific and study the problems and peoples of South America, such readers might well ask themselves whether there is at present any scope for another volume about South America so soon after the publication of Steward's monumental *Handbook of South American Indians*, six volumes, 1946-50. The answer obviously is in the affirmative. For one thing the *Handbook* is hard to come by; secondly, its very encyclopaedic character often makes it difficult to use especially by those non-experts who are quite reasonably more anxious for a synoptic over-view than the ardours of hacking their way through huge mountains of facts. Thus, Steward and Faron will probably never supercede the *Handbook*, but at least their briefer 500-page synopsis serves to fill a gap paradoxically left open by the huge publication. Among other virtues of the

smaller volume is the masterly balance the authors have kept between a multitude of facts on the one hand and a few interpretative principles on the other. We are thus now able to see the wood apart from the trees, and trees themselves take on new significance as they are ordered by a few landscape contours. Steward and Faron are not exactly readable in the popular sense. But their book is written in a plain, sensible literate style, nicely supported by a number of valuable synoptic tables and a minimum number of adequate illustrations.

The *Native Peoples* starts with introductory chapters on the role of environment, production, culture, demography, in the life of the South American Indians. It continues with material on the tribal and linguistic distributions of the 178 local sociocultural groups of South America. This preliminary clearing of the field is then followed by analyses of the more important regional civilisations: Andean, Trans-Caribbean, Tropical forest Chiefdoms, Nomadic Hunters and Gatherers. A final Chapter briefly summarises the origin and development of South American cultures. It concludes with a brief statement about post-European changes and the effects on the aboriginal cultures of present and future industrial influences. The total result is almost that of a small handbook in its coverage, but a handbook that is easily read and comprehensible.

Partly the ease of comprehension derives from the guiding principles of interpretation that Steward and Faron have used to organise their facts. In these principles it is possible to recognise the skilled and highly learned mind of Steward in particular roving easily over the field that he has made so much his own. Rather crudely summarised these principles are as follows: First, the several types of South American cultures are the results of the ways in which these societies have organised themselves in relation to subsistence or food-getting activities and the use that has been made of surplus production for the support of special groups, such as artisans, priests, military and political leaders. Second, Steward and Faron have asked themselves the meaning of the archaeological record, not merely with regard to sequence of types and styles of ceramics, architecture and the like, but more generally with reference to the utmost sociological meaning that can be extracted from the data: why, for example, the desolate coast and high cold interior of Peru and Bolivia developed one of the world's great ancient civilisations and why the northern Andes of Ecuador and the southern Andes of Chile, both borrowing elements from the Central Andes, developed civilisations that differed not only from each other but from the central Andean culture as well. The third principle of interpretation is to organise, where possible, the data round the interaction of the European conquerors and colonists with the Indians in South America. Such principles, simple as they may seem in mere summary, are made to serve as a more than adequate framework for holding together what might otherwise be a mere conglomeration of unrelated facts.

Many readers of this Journal will turn with almost indecent haste after opening the book to read Steward and Faron's summary of transoceanic influences on South American cultures. They will find (pp. 34-41) an outstandingly judicious summary of the biogenetics of cotton, the bottle gourd, the sweet potato, the yam and maize, which concludes in part with the statement, "we must conclude that, impossible as it seems, man somehow crossed the Pacific before 2000 B.C. bringing domesticated cotton and gourds and possibly maize from Asia. Much later he brought yams and on return voyages took the new hybrid cotton, sweet potatoes, hibiscus and perhaps several weeds to Polynesia" (p. 41). Of cultural artifacts like the blowgun, panpipes and bark cloth which have been noted as occurring in both Oceania, Asia and South America, the authors offer the conclusion that "it is impossible

at present to provide a definitive answer to the question of how much influence Asia exerted on South American cultures. Isolated similarities might be explained away as parallel developments, but it seems unlikely that the rather imposing list of botanical and cultural similarities does not show some kind of transoceanic influence" (p. 42). We are now apparently left with the conclusions that *"impossible as it seems"* contact took place before 2000 B.C. and on the other hand, *it is impossible* to answer the question of how much influence took place. A rather negative and non-committal kind of conclusion perhaps, but for those who have tried to remain relatively immune to *Kon-Tiki* enthusiasms, probably the only kind of answer that the data at present permit.

In a necessarily brief review it is impossible to do more than indicate the major achievements of the *Native Peoples.* Its virtues are clarity and good judgement, neither of which however could have been gained except on the basis of extensive knowledge and intensive reflection. The book is not only an outstanding supplement to the *Handbook,* but stands in its own right as the best shorter survey to date of the Indian problems and peoples of South America.

Oscar Lewis, author of the already well-known *Life in a Mexican Village, Tepoztlan Revisited* (1951), and latterly of an interesting study of *Village Life in Northern India* (1958) returns to his Tepoztecans in this book in Mexico. In concentrating on the life of the village Mexican, many of them now living and working in Mexico City, Lewis in his own way is writing the present chapter (though probably not the last) of the saga that, beginning with Redfield, has made Tepotzlan one of the best known village communities in the world. Here the story is brought up-to-date with an account of the adjustment of some Latin American Indians to the demands of contemporary industrial life. Lewis makes the point that poverty has its own culture (an echo of Karl Marx, perhaps?). To define the morphology of this culture he hopes that his Mexican study will be followed by comparative studies of poverty elsewhere in the world. This proposition reminds one of the obverse proposition sometimes made by students of national character to the effect that the middle and upper class inhabitants of Paris, London and New York are more alike in their culture because of their wealth and city life than they are different because of their different social heritages. Whatever the truth in these propositions, we do not have to be concerned with their truth in order to appreciate Lewis' contribution to Mexican studies.

Lewis has developed an interesting technique of "depth analysis" to delineate the effects of poverty on his Mexicans. He simply lays before us five ordinary days in the life of five ordinary representative families: the families are of course fictionalised, but the accounts are based on the facts of everyday living with them. One of the families still lives in a Mexican village, three of them now live in different parts of that great urban sprawl that is Mexico City, the fifth family is that of a post-revolutionary millionaire living in a wealthy suburb. Each story is prefaced by a cast of characters. If one takes time to study this cast, then one has the kind of orientation that makes it possible to follow easily the record of daily incidents. The stories are all vivid, exciting, informative. Taken as a whole they probably provide a better guide to many aspects of contemporary Mexican life than most so-called guides or ethnologies

The reason for this is not hard to find. Most traditionally composed ethnologies, following supposed canons of scientific objectivity, are organised round the description of social systems or structures, in which people are largely irrelevant. Perhaps this is correct if one is writing sociology. But the for-

gotten men of the conventional account go on living, whether the books tell about them or neglect them. It is Lewis' great success that he forces us imaginatively to participate in the lives of these Mexican families. By doing so, we see Mexico with literally our own eyes. We gain an increased appreciation of impact of urbanisation upon a traditional "folk" people. For what is happening today in Mexico must also be happening in Africa, in Asia and in the port towns of Oceania. Mexico may be far removed from the Western Pacific in space, but what is happening there has much to tell us about our own area.

In an appreciative introduction to this book, Oliver La Farge, well-known novelist and friend of the North American Indian, comments on the fact that his dominant impression about these urban Mexicans is the deep-seated malaise of their lives, "the rarity among them of happiness and contentment, the rarity of affection" (p. ix). Other readers will probably have the same impression. The general malaise applies even to the life of the millionaire family, and so must be associated not so much with economic poverty as with the impoverished culture that these families have been able to find or build for themselves in the large city milieu. Their culture turns out to be spurious rather than genuine, as Sapir tried to phrase the matter many years ago. This impression of malaise is of additional interest to the reader because to a certain degree it helps to correct the impression that Lewis gave of these same Tepoztecans in his article, "On Urbanisation without Breakdown" (*Scientific Monthly*,) 75, 1952 pp 31-41. At the time one thought that the implications of that article were almost too good to be true. Now it is possible to see that one's first impressions of the urban Mexican need correcting by the full family histories contained in the present book. These Mexicans may not be living in a disintegrating culture, but they are part and parcel of one that is far from being rich and coherent. Malaise may therefore be the initial common denominator of urbanisation whether it occurs in Mexico or the Pacific.

If Steward and Faron have given us the overall picture of the solar macrocosm that is South America and its native peoples, Lewis helps us appreciate the microcosm of present day Latin American life. The one book is thus an admirable complement to the other. Between the two of them we can learn of the experience of one whole continent as its native peoples run the whole gamut of history from aboriginal civilisation to contemporary urban industrialisation. And what we learn from this one continent has its analogies and parallels in the Pacific. The comparative understanding of this history as a prelude to the study of contemporary social life could very well start from the analysis of these two books on Latin America.

ERNEST BEAGLEHOLE